# The Engineer

LONDON, FRIDAY, FEBRUARY 21, 1941.


## PUBLIC NOTICES

### ADMIRALTY

**ROYAL CORPS OF NAVAL CONSTRUCTORS**

A Competitive Examination for ENTRY into the ROYAL CORPS of NAVAL CONSTRUCTORS will be held in JULY next. Candidates must be not more than 24 years of age on the 1st October, 1941, and must by then have been engaged in practical Shipbuilding Work for at least 18 months. Graduates of the Universities are preferred.

Full particulars may be obtained upon application to the SECRETARY OF THE ADMIRALTY (C.E. BRANCH), BATH. Intending candidates must send to that address, before the 1st April, full particulars of their educational and technical training and of their practical experience.

PRIVATE STUDENTS OF NAVAL ARCHITECTURE.

In conjunction with the above a QUALIFYING EXAMINATION will be held for Private Students who desire to take the same course as that prescribed for Officers of the Royal Corps of Naval Constructors under training. Candidates' applications should reach the SECRETARY OF THE ADMIRALTY (C.E. BRANCH), BATH, before the 1st April. A fee of £50 per session is payable by Private Students taking this Course. 7146

### UNION OF SOUTH AFRICA—CITY OF PRETORIA

**TENDERS FOR PIPEWORK EQUIPMENT**

The City Council of Pretoria invite TENDERS for the SUPPLY, DELIVERY and ERECTION at their Power Station, Mitchell Street, Pretoria, of:

PIPEWORK EQUIPMENT FOR THE POWER STATION.

One copy of the specification may be obtained from the Consulting Engineers, Messrs. Merz and McLellan, 32, Victoria Street, London, S.W.1, on or after 26th February, 1941, on payment of a fee of £5 5s.

Additional copies of the specification may be obtained from the Consulting Engineers in London on payment of £2 2s. for each such additional copy.

Sums paid on any number of copies up to four will be refunded on receipt of a bona-fide Tender.

Sealed Tenders, with all relative documents, endorsed "Tender for Pipework Equipment, Pretoria," must be delivered in triplicate as follows:—

(1) The original Tender and documents to the SECRETARY TO THE TENDER BOARD, OFFICE OF THE HIGH COMMISSIONER FOR SOUTH AFRICA, SOUTH AFRICA HOUSE, LONDON, W.C., not later than 2nd April, 1941.

(2) Two duplicate Tenders and documents to Messrs. MERZ and McLELLAN, 32, VICTORIA STREET, LONDON, S.W.1, not later than 24 hours after deposit of the original Tender and documents with the High Commissioner.

The Council do not bind themselves to accept the lowest or any Tender. 7139

### NOTTINGHAMSHIRE COUNTY COUNCIL

**TEMPORARY ASSISTANT ENGINEER**

Applications are Invited for the POST of ASSISTANT ENGINEER at the Ransom Sanatorium, near Mansfield, Notts. Applicants must have a thorough knowledge of the working of Lancashire Boilers with Automatic Stokers, High-speed Reciprocating Engines driving Alternators, Circulating Pumps, Calorifiers, Low-pressure Hot Water Heating Apparatus, Laundry and Kitchen Equipment. The successful applicant will be required to Take Charge of the Plant during the absence of the Chief Engineer.

The remuneration will be at the rate of £4 10s. per week, plus a War Bonus, which is at present 6 per cent. The appointment will be temporary for the duration of the war with a possibility of permanency thereafter.

Application forms, together with conditions of appointment, may be obtained from me, and should be returned duly completed to the County Medical Officer, Shire Hall, Nottingham, not later than 7th March, 1941.

K. TWEEDALE MEABY,
Clerk of the County Council.

Shire Hall,
Nottingham,
19th February, 1941. 7158

### RIVER OUSE (YORKS.) CATCHMENT BOARD

**CIVIL ENGINEERING ASSISTANT**

Applications are Invited for the POSITION of CIVIL ENGINEERING ASSISTANT on the Board's staff.

Candidates must have passed an examination qualifying for Associate Membership of the Institution of Civil Engineers, and should have had considerable experience in the Design and Construction of Engineering Works, preferably in connection with River Improvement or similar Schemes.

The commencing salary will depend on Engineering Experience, but will not be less than £275 per annum, rising by annual increments of £25 to £350 per annum, plus a temporary War Bonus amounting at present to 6 per cent. of salary, but not exceeding £18.

The appointment is subject to the provisions of the Local Government Superannuation Act, 1937, and to the successful candidate passing a medical examination. The appointment will also be subject to the Sick Allowance Regulations of the Board.

Forms of application and terms of the appointment will be forwarded on receipt of a stamped, addressed envelope.

Applications, endorsed "Engineering Assistant," must reach the undersigned not later than Monday, the 10th March, 1941.

Canvassing, directly or indirectly, will disqualify.

F. M. FARMER,
Clerk of the Board.

7, Langcliffe Avenue,
Harrogate. 7152

TO ADVERTISERS UNDER BOX NUMBERS IN SITUATIONS OPEN SECTION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge, and co-operation is asked for.

## The Engineer

### PRINCIPAL CONTENTS OF THIS ISSUE

ARRANGED FOR CARD INDEXING

(TABLE OF CONTENTS, PAGE 130)


The Hong Kong Centenary and Applied Science—No. III (P. 124)
(C. A. MIDDLETON SMITH) THE ENGINEER, 21 - 2 - 41

Air Force Targets in Germany No. XVII (P. 127)
THE ENGINEER, 21 - 2 - 41

Government Trading in War—No. II (P. 128)
THE ENGINEER, 21 - 2 - 41

Science and the State (P. 134)
(DR. A. V. HILL) THE ENGINEER, 21 - 2 - 41

Erection of Howrah Bridge (P. 134)
THE ENGINEER, 21 - 2 - 41

Ship of the Future (P. 136)
(A. C. HARDY) THE ENGINEER, 21 - 2 - 41

The Engineer and Desert Warfare (P. 130)
THE ENGINEER, 21 - 2 - 41



**BABCOCK VALVE VALUE.**



*INDEX TO ADVERTISEMENTS, PAGE 61*


**PAPER ECONOMY**

**It has now become necessary, in order to maintain the normal circulation of THE ENGINEER, to print all advertisement pages on the Thin Paper hitherto used for the Foreign Edition.**

**So long as our diminishing stocks of thick paper will allow, the Home Edition Editorial pages will be printed on the usual paper, so that uniformity in bound volumes may be maintained.**

## SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

**IMPORTANT**

**Advertisers in Situations Open Column should make themselves acquainted with the terms of**

**STATUTORY RULES & ORDERS**
**1940 No. 877**
**RESTRICTION ON ENGAGEMENT ORDER**

ENGINEER and WORKS MANAGER REQUIRED with wide experience of Diesel Engines, preferably Ruston, International, or Waukesha-Hesselman design; and good experience of all types of Earth-moving Equipment, including Tractors, Scrapers, Bullgraders, Motor Graders, Ruston-Bucyrus Excavators, &c.

A good salary will be paid, and the prospect of a Directorship offered to successful applicant possessed of tact, organising ability, and suitable technical experience.

Applications will be treated confidentially by the Chairman, J. C. Oliver, Ltd., Airedale Plant and Railway Works, Leeds, 10. 7147 A

## SITUATIONS OPEN

ASSISTANT ENGINEER REQUIRED at a Waterworks Pumping Plant equipped with Modern Steam and Electric Machinery. Age not less than 25. Salary £260. Applicants should have some technical knowledge and be able to make Working Drawings. Previous Waterworks or Marine Experience desirable.—Address, with full particulars and date free, P3055, The Engineer Office. P3055 A

CIVIL ENGINFERING CONTRACTORS (PLANT DEPT.).—The following STAFF are REQUIRED:—
ONE ASSISTANT PLANT MANAGER and ENGINEER. TWO PLANT CLERKS with Plant Hire Experience, ONE STOREKEEPER for Tools and Materials. Please state experience, salary required, and when free.
Address, 7123, The Engineer Office. 7123 A

CEYLON.—GENERAL ENGINEERING ESTABLISHMENT REQUIRES, as near as possible to the following specification, well-educated MECHANICAL and ELECTRICAL ENGINEER with personality, single, under thirty, regularly trained, with indenture, technical qualifications essential. Drawing Office Experience, knowledge of the Business Side, including Estimating, Costing, Correspondence, and Salesmanship are necessary, with ability to Meet Competition and Secure Orders. Capable of Directing Native Staff, Interviewing Clients, knowledge of Bookkeeping and Records a distinct advantage.—Address, stating salary required, 7109, The Engineer Office. 7109 A

## SITUATIONS OPEN

CEYLON FIRM of ENGINEERS Engaged on Tea and Rubber Machinery, General Work, and Repairs, REQUIRE Regularly Trained MECHANICAL ENGINEER, with some Electrical knowledge, to Supervise Native Machinists, Turners, Fitters, Blacksmiths, Boilermakers, Moulders, Pattern-makers, Tinsmiths, and Coppersmiths. A good practical man is required, not necessarily a foreman, but one who could act in the Offices or as Outside Engineer if desired. Technical training essential, with experience of Estimating and Drawing Office, also Correspondence. Age under thirty, single, apply, stating salary required.—Address, 7105, The Engineer Office. 7105 A

MACHINE SHOP FOREMAN REQUIRED to take Control of night-shift in West of England Firm engaged in Manufacture of Air Compressors and Aircraft Components. Commencing salary £520 p.a., with prospects of advancement for man with initiative and ability.—Address, giving details of experience, 7115, The Engineer Office. 7115 A

PLANT SUPERINTENDENT REQUIRED, to Take Complete Charge of Plant Department on large Building Contract in Midlands: Rustons, Smiths' Navvies, Scrapers and Caterpillar Tractors, Hoists, Pumps, Dumpers and Lorries. Able to organise maintenance repair and records. Opportunity for right man.—Address, stating experience, age and salary required, 7124, The Engineer Office. 7124 A

PRODUCTION MANAGER, with Up-to-date Knowledge of Heavy Machine Tools for General Forging Trade. Must have experience in shop management, supervising and fixing piecework prices, and be capable of arranging maximum output and production.—Address, 7127, The Engineer Office. 7127 A

THE Post You Are Seeking May Not be Advertised in this Column, but do not lose the Opportunity of Bringing Your Requirements before all those who would be interested and could employ you. An Advertisement in the "Situations Wanted" Column would be seen by all Leading Engineering Concerns for a cost of Four Lines, 4s.; 1s. for each Additional Line. There is no better way of covering so large a field for such a small charge.

## SITUATIONS WANTED

ADVERTISER (44), Experienced Works Manager, efficiency engineer, production, sales, estimating, costing; technically trained: FREE SHORTLY for MANAGERIAL or EXECUTIVE; £800/900 p.a.—Address, P3037, The Engineer Office. P3037 B

A FIRST-CLASS MAN (38), Exceptional Knowledge steel making (O.H.); managerial, technical, and sample passing experience. DESIRES CHANGE. Degree standard, wks. manager's training, foundry wk., metal working, and heat treatment, defects, commercial knowledge, labour control.—Address, P3051, The Engineer Office. P3051 B

AS ASSISTANT or WORKS MANAGER, by Scot. Very wide, proved, and progressive experience, production, design, costing, leading firms. Highest credentials. Unlimited energy for national effort.—Address, P3050, The Engineer Office. P3050 B

B.T.H. Student Apprentice, G.I.P.E., H. Nat. Cert. (Elec.), H. Nat. Dip. (Mech.); electrical, draughting, planning exp., DESIRES POST as ASSISTANT WORKS ENGINEER or sim. Age 27, free; min. salary £400.—Address, P3047, The Engineer Office. P3047 B

CHARTERED STRUCTURAL ENGINEER (38), with 22 years' experience in general, structural, and railway engineering, DESIRES CHANGE of POSITION offering scope for advancement in any capacity.—Address, P3052, The Engineer Office. P3052 B

CHIEF BUYER (29), Fully Conversant with Aircraft and engineering suppliers, A.I.D. procedure and specifications; ambitious, capable of using own initiative. Please state salary offered.—Address, P3048, The Engineer Office. P3048 B

CHIEF BUYER with Wide Technical and Practical experience, comprehensive knowledge of steel and iron ferrous markets. Exceptional ability in organisation of material control and stores. WISHES to Join Larger Engineering Organisation on WORK of NATIONAL IMPORTANCE. Thoroughly conversant with A.I.D. and C.I.A. procedure. Min. salary required £850 per annum.—Address, P3045, The Engineer Office. P3045 B

COMMERCIAL EXECUTIVE DESIRES POST, Manchester Area. Twenty years' experience internal and external administration large engineers; specialist on costs, progress, material control, office management.—Address, P3044, The Engineer Office. P3044 B

ENGINEER, M.I. Mech. E., M.I.A.E., M.I. Mar. E., &c., mech. elec. (47), expert production, organisation, cost reduction, management, sales, FREE. Short period or permanency.—Address, P3020, The Engineer Office. P3020 B


**SITUATIONS WANTED (continued)**
**Page 2**
**AUCTIONS, Page 62**
**SUB-CONTRACTING, Page 62**
**MISCELLANEOUS, Page 62**
**PATENTS, Page 2**
**FOR SALE, Page 62**
**MACHINERY, &c., WANTED, Page 2**



*For Advertisement Rates see First Column Overleaf*


**CLASSIFIED ADVERTISEMENTS CLOSE FOR**
**PRESS—NOON WEDNESDAYS**

# The Engineer

## Annual Subscription Rates

(including postal charges).

| | | | | |
|---|---|---|---|---|
| BRITISH ISLES ... | £3 | 5 | 0 | Thick Paper Ed. |
| CANADA ... ... ... | £3 | 3 | 0 | Thick Paper Ed. |
| | £2 | 18 | 6 | Thin Paper Ed. |
| ABROAD ... ... ... | £3 | 7 | 6 | Thick Paper Ed. |
| (except Canada) | £3 | 3 | 0 | Thin Paper Ed. |

**"THE METALLURGIST."**

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER each alternate month. Next date, February 28th.

**ADVERTISEMENTS.**

The charges for Classified Advertisements are 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12 - per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified advertisements cannot be inserted unless delivered before TWO o'clock on Wednesday afternoon.

*Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of* THE ENGINEER.

Postal Address,
28, Essex Street, Strand, London, W.C.2
Telegr. Address,
"Engineer Newspaper, Estrand, London."
Tel. Central 4565 (10 lines).


## SITUATIONS WANTED

ESTIMATOR (36) SEEKS CHANGE, Mutual consent. Experienced general engineering, aircraft; at present engaged general engineering; good works experience, knowledge Government costing methods. Scotland preferred.—Address, P3045, The Engineer Office. P3045 B

GENERAL MANAGER of Well-known Non-ferrous foundry and machine shop SEEKS CHANGE. Expert organiser. May consider financial interest in small firm.—Address, 7125, The Engineer Office. 7125 B

HEAT-TREATMENT SPECIALIST (30), Free to take up position. Thorough practical experience in all branches and familiar with recent development and modern methods.—Address, P3053, The Engineer Office. P3053 B

IF the Man You Are Seeking is Not Amongst those Advertising in this Column, a Small Announcement in the "Situations Open" Column will Quickly and Economically Produce the Right Selection of Applicants, at the same time Eliminating Waste of Effort, Waste of Time, and Waste of Opportunity. The charge is Four Lines or under, 4s.; each Additional Line, 1s.; Box Numbers, 6d. extra, which includes despatch of all replies.

MECH. ENGINEER (50), Fully Qualified and specialised in detailed costs of production, time studies and estimates, is PREPARED to ADVISE on MOST ECONOMICAL METHODS to Obtain Maximum Outputs. At present holding executive position; DESIRES CHANGE.—Address, P3049, The Engineer Office. P3049 B

STUDENT of Mechanical Draughtsmanship, Age 22, course finishing in one month, WISHES SITUATION as JUNIOR DRAUGHTSMAN with firm in North America.—Address, P3054, The Engineer Office. P3054 B

TOOL, Electrical, Marine, Sound, Practical, D.O., executive, England and abroad, good organiser (47), PARTNER or SUPERINTENDENT with person who considers happiness prime mover to increase output.—Box 2, Smith's Bookstall, Northwood, Middx. 7155 B

## MACHINERY, &c., WANTED

WANTED, TWO D/E PUNCHING and SHEARING MACHINES; average gaps; capacity of dealing with material up to ¾in.
TWO S/E PUNCHING MACHINES up to ¾in.
ONE FLANGING MACHINE up to ¾in.
ONE SET ROLLS about 8ft. long for material up to ¾in.
Full particulars.
Address, 7138, The Engineer Office. 7138 F

WANTED, ONE HORIZONTAL BORING MACHINE; 6in. spindle, 8ft. traverse. Full particulars.—Address, 7150, The Engineer Office. 7150 F

WANTED, PLATE BENDING ROLLS (Three-roller Type); ¼ cap. of bending a plate about 28ft. to 30ft. in length by, say, ¾in. to 1in. in thickness. Full particulars.—Address, 7151, The Engineer Office. 7151 F

WANTED, ONE "Snow" PARALLEL GRINDING MACHINE, with side and top grinding. Full particulars.—Address, 7149, The Engineer Office. 7149 F

ALFRED HERBERT, Ltd., Coventry, PAY BEST PRICES for SECOND-HAND MACHINE TOOLS in good condition, by first-class makers.
Write, wire, or 'phone, and our representative will call.
'Phone: 8781 Coventry; Telegrams, "Lathe, Coventry." 1002 F

COMBINED SHEARING and CROPPING MACHINE, mounted on bogey preferred; capacity 6in. × 6in. angles, ¾in. flats. Must be modern type. Also ROLLER-TYPE STRAIGHTENING MACHINE for Mild Steel Wire; maximum capacity ¾in. diameter.—Details to J. F., Staffa Works, Staffa Road, E.10. 7148 F


PLEASE OFFER US
YOUR SURPLUS MACHINES

As Licensed Dealers in Machine Tools we have numerous inquiries on our books for all types of machines for work of vital national importance. Our representatives will inspect and make spot cash offers for machine tools and sheet metal working machinery of every description.

F. J. EDWARDS, LTD.,
359, EUSTON ROAD, LONDON, N.W.1
Telephone No.: EUSton 4618
Telegrams: "Bescotools, Norwest, London."


LATE Bending or Flattening Rolls, Deal with a plates up to about 6ft. by ¾in. Also ¼-yard or larger Excavator, Diesel preferred. — FRED WATKINS, Coleford, Glos. 6759 F

11½IN. Coventry DIEHEADS REQUIRED URGENTLY; any condition.—Particulars to GUEST and CHRIMES, Limited, Rotherham. 7135 F


SPRAY COOLING PLANTS
STEAM & WATER-JET APPARATUS
OF ALL DESCRIPTIONS.

MULTI-JET CONDENSERS
FOR TURBINES and RECIPROCATING ENGINES.
GAS EJECTORS FOR OIL TANKERS
SAND & MUD ELEVATORS
GILLED HEATING PIPES

*Catalogues on Application.*

KORTING BROS. (1917) LTD.
*(AN ALL BRITISH COMPANY)*
SHEEPBRIDGE LANE, MANSFIELD, NOTTS.



ENQUIRY DEPARTMENT

The fact that our Enquiry Department is unquestionably filling a want in the engineering world daily becomes more apparent, and the Proprietors of "The Engineer" welcome enquiries from all who require information of a technical or commercial nature.

This Department contains an extensive trade name index, a large technical library, and catalogues of most of the prominent manufacturers.


## PATENTS

THE PROPRIETORS of PATENT No. 481,488, for "Apparatus for Sizing Tubes," are DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCE or otherwise for the purpose of EXPLOITING this invention and ensuring its full development in this country.—All communications should be addressed to H. N. and W. S. SKERRETT, 24, Temple Row, Birmingham, 2. 7143 H

THE PROPRIETORS of the Following PATENTS, namely, No. 443,419, "Means for Holding and Feeding Profiled Work Stock in a Lathe or the like"; No. 443,478, "Rolled Profiled Blanks"; No. 443,541, "Producing Profiled Articles of Circular Section," and No. 406,213, "Roller Bearings," are DESIROUS of EXPLOITING these inventions and ensuring their full development in this country.—All communications should be addressed to H. N. and W. S. SKERRETT, 24, Temple Row, Birmingham, 2. 7144 H

THE PROPRIETOR of the PATENT No. 405,946, for "Wire Rope and Method of Making Same," is DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCE and otherwise on reasonable terms for the purpose of EXPLOITING the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to Haseltine Lake and Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2. 7145 H

**For continuation of Small Advertisements see page 62**


HARRY F. ATKINS
M.I. MECH. E.
CONSULTING ENGINEER
(MACHINE TOOLS & PROCESSES)
OLD FLETTON
PETERBOROUGH

Vertical Milling Machines
all geared, hardened and ground throughout, ball and roller bearings, swivelling head, 30" x 8" Table
HENRY MILNES LIMITED, Machine Tool Works, Ingleby Street, BRADFORD

*Acknowledgments to Manganese Bronze and Brass Co. Ltd., Woodall-Duckham Co. (1920) Ltd., and Hadfields Ltd.*

The modern development of refractory materials owes much to close co-operation between manufacturer and user of refractories. As Britain's leading manufacturers, General Refractories enjoy the custom and confidence of many thousands of refractories users engaged in every branch of the metallurgical, engineering and other industries of the world. This intimate relationship provides "G.R." engineers and chemists with a real close-up picture of the actual needs of every type of user. In addition, it provides an invaluable fund of practical experience—which proves the soundest basis on which to maintain and develop a high standard of consistently uniform quality products. This method of procedure is your assurance that there is not only a "G.R." product made for your particular business—but that if you have a problem involving refractories, "G.R." data and experience will help you to find the answer.

GENERAL REFRACTORIES LTD.
HEAD OFFICE: GENEFAX HOUSE, SHEFFIELD, 10. TELEPHONE 31113 (6 LINES)
G.P.S.

FIREBRICKS: *Glenboig Special, Glenboig Special Crown, Glenboig, Glenboig Crown, Castlecary, Dykehead, Gem, White Carr, Stour, Hycone, Alumantine, Hystilyn, Adamantine, Llangennech.*
BASIC BRICKS: *Spinella, Saxpyre, Supermag, Diazite, Dolomax.*
ACID-PROOF REFRACTORIES: *Obsidianite, Losol.*
INSULATION: *Amberlite* Bricks, Cement and Concrete.
SILICA BRICKS: *Lowood, Meltham, Allen, Quartex.*
CEMENTS: *Sintex, Durax, Pyrolyte.* PLASTICS: *Durax, Rotaline, Plastic K-N., Glendoline, Ground Ganister.*
SILLIMANITE: Tank Blocks, Bricks and Cements.
SANDS: Moulding, Brick Facing, Silica, Glass.

# A Seven-Day Journal

## Emergency Repair of Air Raid Damage

ON Friday, February 14th, it was announced that Lord Reith, the Minister of Works and Buildings, had been informed that a doubt had arisen in some quarters about the functions of the department of his Ministry dealing with emergency repair and air raid damage to factories and other buildings, to the head of which Major-General K. C. Appleyard, C.B.E., was recently appointed. That appointment, we may recall, was recorded in last week's Seven-Day Journal. Lord Reith wishes it to be clear that the responsibilities of Sir Peter Bennett, Director-General of the Emergency Services Organisation in the Ministry of Aircraft Production, and of his Emergency Reconstruction Panels are not affected by the new appointment. In order to prevent confusion of functions, the department in the Ministry of Works will be known as the Emergency Repair Department with General Appleyard as its Director. The Department will procure and arrange the flow of materials and additional labour in districts where serious damage occurs, and place at the disposal of the Local Reconstruction Panels, as well as other bodies, technical advice on repairs and reconstruction, and assist as and where necessary in any other cognate matters. The Emergency Services Organisation and its local Reconstruction Panels will have the same responsibility as before for securing the rapid restoration of production in damaged war factories.

## Ministry of Works and Buildings, New Appointments

ON Tuesday, February 18th, it was announced that Lord Reith, the Minister of Works and Buildings, has recently made the following appointments in the Building Priority Department: Mr. Paul Gilbert, the director of a leading firm of building contractors, is made Director of Building Programmes; Mr. R. G. Cromell, the President of the Building Merchants' Alliance, with expert knowledge of roofing materials and construction, becomes Director of Roofing, while Mr. Guthlac Wilson, M. Inst. C.E., A. Am. Soc. E., is appointed Director of Constructional Design. Under the Director of Bricks, the following appointments have been made: Mr. W. Henderson Cleland becomes Commercial Adviser, and is to undertake on behalf of the Ministry investigations into the application of the Price of Goods Act to the price of bricks; Mr. George Gee, who is the chairman of a prominent firm of building contractors, is appointed Assistant Director in Charge of Brick Stocks, and will deal with the question of brick reserves; Mr. E. H. Palmer, F.S.I., who is partner in a firm of quantity surveyors, has been appointed Deputy Director of Bricks (London), and he will assist Mr. T. P. Bennett, the Director of Bricks, and will co-ordinate the activities of the Area Deputy Directors. In accordance with the policy of the Ministry for the closer co-operation of the brick industry, Deputy Directors of Bricks have been appointed by the Minister for the following areas: Scotland, Mr. Lockhart W. Hutson; North-Eastern and North Wales, Mr. Spencer Silcock; Central Midlands, Mr. Arthur J. Philips; South-Western and South Wales, Mr. G. Cattlin; and South-Eastern, Mr. W. E. Watson.

## Canals in Wartime

ACCORDING to an official announcement on Monday, February 17th, Lieut.-Colonel Moore-Brabazon, the Minister of Transport, has appointed Mr. Frank Pick to investigate and report upon the carriage of traffic upon canals and inland waterways. The announcement is welcomed by all those who are engaged in Britain's canal industry, more particularly as recently some dissatisfaction has been expressed as to the part our inland waterways are playing in the wartime transport organisation of the country. This matter was recently referred to by Sir William Prescott, the Chairman of the Lee Conservancy Board, who, in a letter to *The Times*, pointed out that whereas some of our canal systems are well employed, there are others which have barges lying idle and could well take on more traffic. Sir William pointed out that canal traffic is being hampered by lack of the necessary labour for the working of the barges, and for keeping the canals and locks in good order and maintaining them in a state of efficient operation. As a help to the industry, Sir William put forward the suggestion that suitable men might well be exempted from military service, those which had already been called up might be returned, and an effort should be made to restrict men who are engaged on waterways from transferring their services to other occupations. Finally it was suggested that should a shortage of labour still exist, then the Government should make up that shortage by transferring labour from the Army. The restoration of our canal systems has been more than once a subject of Government inquiry and report, and almost without any exception such reports have always been in favour of utilising to the full our inland waterways. Some of our canal systems have been greatly improved within the last few years and are operating on an efficient basis. Among these we may mention the Lee navigation system, and that of the Grand Union Canal Company, with its important connections to Midland towns. Even these canals could, it is pointed out, carry more traffic if their difficulties were met and overcome, while other systems not so well employed at the present would greatly benefit.

## Fire-Detection Devices

THE Institution of Electrical Engineers Advisory Committee to the Ministry of Home Security has just completed a memorandum entitled "Fire-detecting Devices, with special reference to the Detection of Incendiary Bombs." It is to appear in the February number of the Institution's *Journal* (Part I), and copies can also be obtained from the Secretary of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2, price 6d. The memorandum deals with methods of detection, having in view mainly the 1 kilo. magnesium bomb which has a light output of about 6000 candle-power and a heat output of about 15,000 B.Th.U. Various methods of detection are considered, such as impact, sound, light, products of combustion, and heat, and in the following section short descriptions of each type of detector are given, dealing with impact detectors, it is stated that the impact of a falling 1 kilo. bomb at the moment of first contact with a roof is of the order of 4200 foot-pounds; after penetration it may be capable of exerting only a small force on any lower obstruction. Impact-detecting devices may have to operate within fairly wide limits of impact energy. Among light detectors the different designs such as selenium (photo-conducting) cells, photo-electric (photo emissive) cells, and rectifier (photo-voltaic) cells are dealt with. In the fire detectors the two main classes are described, those depending on the presence of smoke and those depending upon the generation of heat, added to which there are combined systems and also radio-active cells for the detection of fumes. Under the heading of maintenance it is advised that whatever system may be adopted, it is very essential that all the component parts should be efficiently maintained, and in order to ensure this periodic tests should be carried out. For the large installations which may be designed and installed by specialist firms, a servicing agreement may be agreed upon for maintenance.

## The Settlement of War Risks Claims

WE learn that the Board of Trade is anxious to make a fresh effort in order to speed up both payments on account and the final settlement of claims under the commodity insurance scheme of the War Risks Insurance Act. Within the next few days directions prepared by the Board of Trade showing how it can be done are to be sent out through the Board's agents—the insurance companies and Lloyd's, who issue the policies—to every trader in the country whose stocks are insured under the scheme. It is estimated that about 250,000 traders are insured under the scheme. Meanwhile, the Board calls attention to its readiness to facilitate prompt payments on account of claims, where from any cause final assessment may be protracted, or a trader is likely to suffer hardship from lack of financial means pending final assessment and settlement. Traders who have already sent particulars of their claims to their insurance companies or Lloyd's, and wish to obtain payment on account, are invited to apply direct to the Board's assessor dealing with the claims. In cases where completed particulars of claims have not been given, a trader desiring payment on account should write to the agent—the insurance company or Lloyd's—through whom the policy was issued. No special form is needed, but the policy holder should state the address of the premises where the loss occurred, the date and cause of the loss, the nature of the goods, the estimated amount of loss allowing for salvage, and the grounds of application for payment in advance of the final settlement.

## A New Indoor Shelter

LAST week it was officially announced by the Ministry of Home Security that a new type of indoor shelter has been designed by the Ministry experts, and will shortly be available in the areas which are likely to suffer from severe air attack. The new shelter has been called a table shelter, since it has been designed primarily for use in a lower ground floor room. It is a steel structure with a strong top which can be used as a table. There are four corner supports, and when in use wire screens can be hooked on the sides and ends. The structural strength is such as to enable the shelter to resist falling *débris*, and a way of escape by the detachable ends and sides is provided. Inside the shelter there is a mattress on which two adults and one child or two small children can sleep. The new shelter, it is stated, is not regarded as a universal solution of the shelter problem, nor will it replace the existing types of shelter. The advantages of this particular type, it is claimed, is further dispersal, as people remain in small groups, in their own homes, with a corresponding decrease in sanitary and health problems; also that the shelter is simple to erect as only a spanner and a hammer are required for the work, which may be done by the householder. The Ministry of Home Security has also announced that the class of people who will be eligible for a free shelter is to be extended from the income limit of £250 per annum to that of £350. Even so, the supply of table shelters will not be large for some time owing to the limitation of supplies of steel imposed by the Production Executive Committee. Preparations will start soon, however, and it is expected that the first shelters to be delivered will be to dangerous areas and to homes which have no alternative shelters, either Anderson shelters, or brick surface shelters.

## Speeding up the Shipment of Exports

THE Board of Trade has announced its intention of speeding up the shipment of exports. The turn-round of ships in port is to be quickened, with, it is hoped, less waste of shed accommodation, an easier flow of road and rail transport, and a smoother delivery of goods to the ports. Any exporters who may experience difficulties in obtaining the necessary rail transport for their goods are advised to get into touch promptly with the District Goods Officers of the railway companies. Many difficulties, the Board of Trade states, can be overcome in that way. Others can be dealt with by the Board's representatives on the Area Boards, under whom, in some areas, Board of Trade transport officers are already working. Exporters should also be guided by their own forwarding agents as to the right time for sending their goods forward. Serious delay has often been caused and goods have had to be returned from the docks to manufacturers, owing to the failure of exporters to acquaint themselves with, and comply with, the export control requirements which are so essential in wartime. It is further pointed out that before goods leave the country it is necessary that full details about them be supplied to the Customs authorities so that the goods can be "pre-entered" and checked. Particulars of pre-entry requirements may be obtained from the Customs. Full information concerning exchange control is also available from the Customs or from any bank. If exporters will see that as far as possible entry forms have passed through the Customs before the goods are sent to the docks, the shipment of goods for export will be considerably speeded up. The Customs authorities have, on their part, already simplified and quickened the procedure. For certain Empire destinations the requirement of pre-entry for goods not on the prohibited list has been suspended for a trial period. At present it is not possible to go further in this direction without sacrificing the essentials of export control. It is now necessary for the exporters to do their part.

## Producer Gas for Road Transport Vehicles

IN the course of his chairman's address at the forty-fourth annual general meeting of Thomas Tilling, Ltd., which was held in London on Tuesday, February 18th, Mr. John F. Heaton, the chairman and managing director of the company, referred to fuel supplies and the experiments which his firm is carrying out in operating road transport vehicles converted to use producer gas. During the past year, Mr. Heaton said, further extensive experiments had been made by Thomas Tilling, Ltd., and many of its companies. While it was felt that the investigations were still in the early stages, the research work carried out had been so productive that it had been decided to operate one depôt—not yet a large one—with vehicles run entirely on producer gas. From the results so obtained, it was hoped to evolve further improvements. On the purely scientific side of gas producer design and operation, the problems met with were being dealt with on behalf of the company's interests by the Mining Department of the University of Birmingham under the general direction of Professor Neville Moss and Dr. S. Ward. Close contact was being maintained with the University, and it was hoped that by the research work which had been initiated by the company some of the rather obscure operational problems which were met with in the earlier experiments would be overcome. In general, Mr. Heaton said that there had been a lot of uninformed criticism on the operation of vehicles on producer gas; but as far as his company was concerned he was in a position to say that they were satisfied with the progress that had been made.

# The Hong Kong Centenary and Applied Science

By Dr. C. A. MIDDLETON SMITH, M.Sc., M.I. Mech. E., LL.D.

No. III

(*Continued from page 110, February 14th*)

### STEAM POWER AND THE SUEZ CANAL

BRITISH mercantile liberalism insisted that, throughout its history, the Colony should be a free *entrepôt* for the China trade, and all nationals have had equal chances to take part in trade and commercial development in Hong Kong. Commerce, applied science, finance, and industry have flourished, for there was no hindrance, as in China, where internal unrest and the restrictions of an archaic system of Government delayed the civilising work of engineers, medical men, and international trade.

There can be no doubt that the fact that no taxes would be levelled on imports and exports, and that the harbour of Hong Kong offers such good anchorage, stimulated trade and increased shipping returns as time went on. Yet in those early years progress seems (to those of us who have witnessed the astonishing developments in the Colony during this century) to have been very slow. When the Suez Canal was opened (1869) the distance from London to Hong Kong was reduced and steamers were competing with sailing ships. The voyage between the two ports is, in distance, 13,180 nautical miles *viâ* the Cape, and 9799 *viâ* Suez, a saving of 25·6 per cent. in distance *viâ* Suez, and probably a greater saving in time.

Mechanical transport has been the chief factor in the astonishing increase in the trade and population of Hong Kong since the opening of the Suez Canal. But one of the striking features of the economic history of the Colony, as of all British Colonies, has been the willingness of British investors to risk their capital in new enterprises. On the whole, they have been well repaid. Anyone who subscribed for original shares in the Hong Kong Electric Company, Ltd., and held on to them until now, must have received in dividends and the increased value of shares, bonus shares, &c., anything up to, or more than, an average of 20 per cent. on his money.

In 1860 China ceded to Britain a piece of land on the mainland, a small area on the peninsula facing the City of Victoria and called Kowloon. It was for military reasons that this concession was desired; but the possession of this territory led to the establishment of extensive wharves and ship-repairing yards on the mainland.

In 1898 the British obtained the lease of about 300 square miles of territory on the mainland. The lease is for ninety-nine years and expires in 1997. The result of these concessions has been that on the mainland, opposite the City of Victoria, there has arisen, almost suddenly, a new city, Kowloon. As some indication of the rapid expansion of this city, it may be mentioned that on my arrival in the Colony in 1912 the population of Kowloon was stated to be about 30,000; last year (twenty-seven years of growth) the number was over 400,000. This new or leased territory is now invaluable for water supply to the island.

Hong Kong is a nodal point for the distribution of cargo. Vessels from Europe discharge goods in the port, where they are transhipped for China, the Philippines, &c. Vessels from Australia and America bring to Hong Kong goods which are sent on in other ships, not only to China, but to the large islands in the South Seas and to India, Siam, French Indo-China, &c. As the size of the ships increased, so did the docks and facilities for ship repairs in the Colony grow in size.

It is only right that mention should be made of a very remarkable financier, an Armenian, who arrived in the Colony from India in the 1850's as a youthful bank clerk. For many years Mr. (later Sir) Paul Chater was the pioneer in technical enterprises. He realised the possibilities for mechanisation. He formed companies which built wharves and warehouses for cargo; he amalgamated scattered dockyards into one concern and he supported any schemes for improving their equipment. When a representative of an English firm making electric batteries happened to pass through the Colony, about fifty years ago, and suggested that there should be electric light, he was told that only Chater could push the scheme through, and so he had to agree to Chater's technically poor plans. Later it was Chater who formed a company for electric trams for Hong Kong. A man with a tremendous faith in the future of the Colony, and a firm belief in the advantages of modern engineering equipment, he was the power that financed many of the most important commercial engineering works in Hong Kong for nearly sixty years from, say, about 1860 onwards to 1920. As a member of the Legislative and Executive Councils, he urged the creation of many public works. And yet my outstanding memory of Chater, with whom my duties in Hong Kong brought me into intimate contact, is that he was very simple, except in connection with any scheme for making money or improving his beloved Hong Kong. But Chater made me realise how dependent upon financiers are engineers for their livelihood.

### DOCKYARDS AND SHIPBUILDING

Although the City of Victoria is on the north side of the island the first dry dock was built on the south side, at a place now called Aberdeen, a word easier to pronounce by Europeans than the Chinese name for this village on the seashore.

The Hong Kong and Whampoa Dock Company, Ltd., was formed and incorporated (1868), absorbing the most important local ship-repairing establishments. The head office is situated at Kowloon Docks, adjoining Kowloon City, on the mainland. The No. 1 dock there can accommodate the largest ship on the China Station, flying the White Ensign, and also the largest merchant vessel calling at Hong Kong. This firm owns also the Cosmopolitan Dock, on the mainland, in Kowloon City, and also two dry docks at Aberdeen. The No. 1 dock at Kowloon is 700ft. long, 95ft. in breadth at entrance at top, 88ft. at bottom, and 30ft. depth of water over sill at ordinary spring tides. In No. 2 dock the length on keel blocks is 371ft. There are two patent slips, one of length 240ft., the other 230ft. length on keel blocks, both with a breadth at entrance of 60ft.

The Cosmopolitan Dock has length on keel blocks 466ft., breadth at entrance 85½ft., depth of water over sill at ordinary spring tides 20ft. At Aberdeen the Hope Dock has length on keel blocks 430ft., while the Lamont Dock has length on keel blocks 333ft.

There are nine building berths at Kowloon, ranging from 450ft. up to 900ft., and this firm can build vessels up to 700ft. in length. The sheers at Kowloon can lift 100 tons; at low tide the depth of water alongside is 24½ft.

### THE TAIKOO FIRMS

In the City of London there is an unostentatious building in Billiter Square which is the nerve centre of very large British interests in China. When, in 1912, out of the blue, there came a cable from Hong Kong inviting me to become Professor of Engineering out there, it was my endeavour to discover something about this remote Colony, then just a name in my mind, and a tiny red dot on the map in my atlas. My first call was at the Colonial Office, where a certain Mr. Stubbs was in charge of the Hong Kong section; he came out to Hong Kong as Governor in 1920. He painted for me a gloomy picture of Hong Kong, suggesting it was absurd for me to give up a life appointment in the University of London to go out to this place, which he had visited, and had apparently thoroughly disliked. Nor were my researches in the Royal Colonial Institute more encouraging. They revealed statistics of an alarming death rate in the early days, and a description of the island that made me visualise a rock like Gibraltar, instead of one of the most beautiful places on earth. A friend in the city gave me a letter to a firm alleged to have shipping in the Far East, but their ships traded in the West Indies. However, they suggested a call on John Swire and Sons, Ltd., and so it was in the unostentatious offices in Billiter Square that my first reliable information about Hong Kong was obtained, after three days of active search in London. Mr. John Scott was then the senior partner; he had lived for years in Hong Kong. He showed me Lugard's Blue Book on the University, commenting favourably both on the institution and the Colony. After a long interview my thanks ended with the words: "Well, Mr. Scott, it was extremely good of you to spare the time for a complete stranger." To which he replied: "We are interested in engineering in the University, as the Professor appointed will fill the Taikoo Chair, Taikoo being the name by which our firm is known in China."

It was, however, Sir Alfred Ewing who decided my fate. He had written an introduction to our "New Steam Tables" (Smith and Warren, 1912), a work of drudgery completed at his suggestion. It was while discussing this work that Hong Kong was mentioned, and he said that it was a great place with a wonderful future. He was unaware of the size of the interests of the Taikoo firms in the Far East, but he was convinced of the importance to the Empire of Hong Kong.

The London firm of John Swire and Sons, Ltd., controls a large fleet of about eighty ships that have carried the Red Ensign along the coasts and waterways of China. This firm also controls the Taikoo Dockyard and Engineering Company, Ltd.; the Taikoo Sugar Refinery, and a number of wharves and warehouses in the Far East. They act as agents for the famous Blue Funnel Line of Alfred Holt and Co., Ltd., of Liverpool. They trade in the Far East as Messrs. Butterfield and Swire.

John Swire and Sons, Ltd., and their associated firms, gave £40,000 to the endowment fund of the Hong Kong University. The first Chair to be created in the University was named the Taikoo Chair of Engineering. It was (about) ten years after the University had commenced work that the firm gave an additional 100,000 dollars (Hong Kong currency) for the benefit of the Engineering Faculty.

It was natural that the Taikoo Dockyard should be one of the first places to be visited on my arrival in Hong Kong. My training at Keyham had enabled me to keep in touch with marine work. My first visit to the Taikoo Dockyard convinced me that it was as well equipped for repairing large ocean-going ships as any dockyard in Britain. It was later, in 1917, that the construction of the Blue Funnel 8000-ton vessels commenced, although steamships up to 4000 tons had been built and engined in the dockyard for some years. And now, in the Empire emergency, ships up to 10,000 tons have been launched from the Taikoo Dockyard.

The main work, however, of this establishment, since it began to operate in 1908, has been docking and overhauling ships and their equipment. There is a British staff, numbering about 100; this includes management, draughtsmen, foremen, &c. The artisans, labourers, &c., are Chinese; at times as many as 5000 have been employed on work connected with this yard. There are few, if any, places in the world that can compete with Hong Kong in the matter of costs to owners and time required for ship repairs, and there is no question about the quality of the work done. The Far Eastern manager of a British shipping line told me that his firm had saved many tens of thousands of pounds per annum by using Hong Kong for annual repairs.

The Taikoo Dockyard is situated on the north side of the island, at the eastern end of the harbour. There were difficulties due to the site, the chief of which was the sheet granite formation of the island in that locality, which must have made the construction of the large dry dock and the levelling of the whole area of the dockyard very expensive—it ran into millions of pounds sterling. The large dry dock is 787ft. long; it was originally 88ft. wide at entrance, but is now 93½ft. wide; the width at coping is 120ft., and at bottom 77½ft. Depth of water over sill is 34½ft. A feature of the dock is the caisson, of the box-siding type, and electrically controlled.

There are three slipways, capable of taking steamers of 4000, 3000, and 2000 tons displacement.

The building yard is 500ft. long and 500ft. wide, and is equipped for the construction of passenger and cargo vessels. Extensive engine and other shops are equipped with the most up-to-date machinery and appliances, and all classes of steam engines, including geared turbines, have been built; also diesel type engines. An electric crane on the sea wall can lift 100 tons at a radius of 70ft.; wagon and crane roads are provided. A qualified metallurgical staff is of

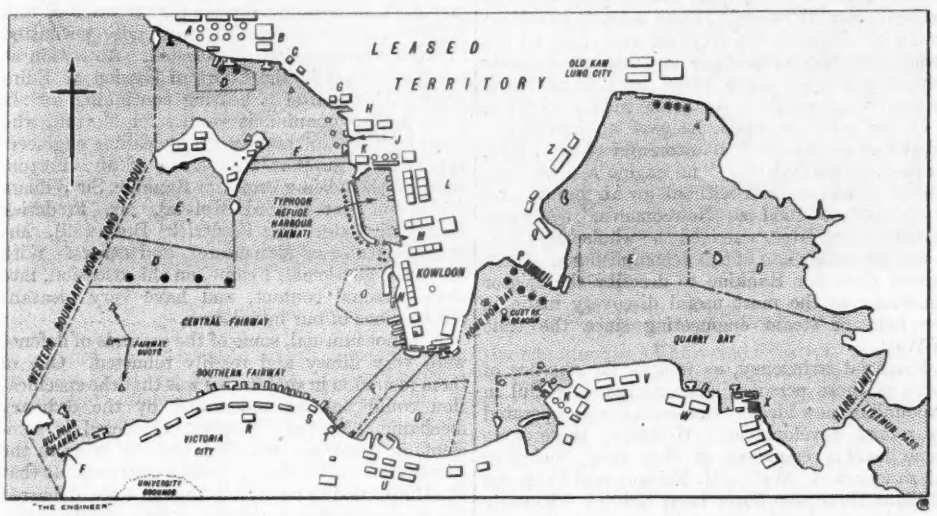
great value, not only to this yard, but to the Colony.

The Hong Kong and Whampoa Dock Company, Ltd., is a British company with a large British staff. It has a longer history than the Taikoo Dockyard. Chater succeeded in bringing together into one organisation British firms that had been competing, and for years the amalgamated concern had a monopoly of overhauling the larger vessels and their equipment. There are local stories of those days when many ships were waiting for repairs and very high prices were charged in busy times. It is not improbable that high charges and delays were the cause of the creation of the Taikoo Dockyard. Perhaps the fact that members of the famous family of Scott, of Greenock, have been closely associated with the firm of John Swire and Sons, Ltd., had something to do with the decision to build a dockyard in Hong Kong. My own belief is that Chater's policy of making shipowners pay what local tradition says were extortionate prices for repairs, &c., was short-sighted; it finally, for a time, limited the activity of his dockyard. But in the end the Colony and shipowners benefited. Shipping volumes increased, and to-day the shipyards in Hong Kong are full up with work.

Although more space has been devoted to a consideration of the Taikoo Dockyard than to its Constructor and his assistants, an Engineer-Captain, with three Engineer-Commanders, a Chief Electrical Engineer, with assistants, and a Chief Civil Engineer, with assistants. There is also quite a large British staff, including stores department, draughtsmen, clerks, police, &c.

There is a large dry dock which has accommodated H.M.S. "Hermes," the aircraft carrier, and other dry-docking arrangements. There is also a large basin alongside the walls of which a number of naval vessels can be seen at almost any time. There is great competition amongst Chinese workmen to be taken on to the pay roll of the naval yard; possibly the knowledge that it is a Government concern gives them a sense of security and perhaps they "gain face."

It should be stated that the two big ship-repairing firms mentioned above have done a great deal of work for the Admiralty, and no doubt will continue to do so. The official records for labour employed in Hong Kong shipyards, three years ago, was over 10,000, but there is so much sub-contracting done and so many local industries associated with ship repairing and shipbuilding that very many more men are dependent on the industry. Steam and oil propelling machinery for big ships has been built in the Colony, and when it is remembered that these fine dockyards have handled not only British vessels, but some of




A.—Standard Oil Company
B.—Ice and Cold Storage Company
C.—Kailan Mining Company
D.—Dangerous goods anchorage
E.—Quarantine anchorage
F.—Telegraph cables
G.—Sam Shui Po
H.—Kwong Hip Lungs slipway and yard
J.—Cosmopolitan dock
K.—A. P. Company
L.—Coal yards
M.—Government slipway
N.—Admiralty stores
O.—Man of war anchorage
P.—Kowloon docks
Q.—China Light and Power Company
R.—Police station. Mercantile Marine office
S.—Harbour office—typhoon signals
T.—G.P.O.
U.—Royal naval dockyard
V.—Electric Light Company
W.—Taikoo sugar house
X.—Taikoo dockyard
Y.—Kai Tack aerodrome
Z.—Green, Ltd., cement works

MAP OF THE PORT OF HONG KONG

friendly rival, it must be understood that both of these establishments possess very much the same facilities for ship repairing, shipbuilding, &c. The management of both concerns gave me generous help and encouragement during my service in Hong Kong and provided facilities for our Chinese engineering students to obtain practical experience in their shops. It seemed to me that very few people in the Colony realised the tremendous responsibilities and the strenuous efforts made to keep up to date in equipment which local conditions imposed on the managers of these large establishments. It seemed a pity to me that with their great experience of Chinese labour, and their useful technical knowledge, they were not members of the local Legislative Council.

There is a smaller dockyard under British management, where river steamers have been built; there are also a number of Chinese-controlled yards. In some of these latter river steamers and numerous powered launches have been built. The equipment of some of these yards is astonishingly poor, and it is amazing that the work can be done so well. The local Government employ a staff of surveyors, and work done for any power-driven launches or ships is inspected by them. There are also several firms of accredited surveyors, including Lloyd's.

The Royal Naval Dockyard is an important establishment, and in spite of the creation of the Singapore base in recent years, the various shops in the Naval Yard were extended in my time. A Commodore is in command; he is, of course, responsible to the Vice-Admiral of the Fleet in China. The technical staff consists of a Chief

the largest Dutch, French, American, and Japanese ships—indeed, ships of almost every nation sailing the China seas—it will be realised that they are an important factor, not only in the economic life of the Colony and China, but of the British Empire.

### WHARVES AND GODOWNS

There is every modern facility for handling cargo in Hong Kong, but the visitor is always astonished to see a number of ships loading or unloading in the harbour, the vessels being surrounded five deep on either side by native craft, junks, and sampans. Transit by these craft or lighter takes place. A great deal of cargo, especially from vessels arriving from Europe and America, is landed at the wharves. The two largest concerns engaged in this work are well equipped and have godowns (stores) of reinforced concrete.

The Hong Kong and Kowloon Wharf and Godown Company, Ltd., is another of Chater's creations. There is a water frontage 2000ft. in length at Kowloon. The total area of the property is 1,201,350 square feet.

There are nine pier berths capable of berthing at lowest spring tides steamers up to 650ft. in length and with a draught of 32ft. There is a railway connection with the line from Kowloon to Canton. The godowns can store about 300,000 measurement tons of goods, and there is an open space of area 343,343 square feet for storing timber and cargoes not needing cover. Electric conveyors and electric cranes are in use; there are also sixteen cargo cranes on shore and five afloat, with a lifting capacity up to 25 tons. On the island there are other godowns belonging to this firm, which has a fleet of eleven steam and motor tugs and launches and 114 lighters up to 200 tons capacity.

### THE BLUE FUNNEL LINE

Holt's Wharf has an area of 108,000 square feet and a frontage of 1600ft., with storage capacity of 25,000 tons in godowns of reinforced concrete. Two vessels up to 15,000 tons can be berthed at one time, the minimum draught of water alongside being 51ft. There are four locomotive cranes and one fixed crane. There is rail connection with Canton.

It has often been said that, under normal conditions, a Blue Funnel steamer can be seen in every coast port in China. British residents in the Far East take pride in the reputation for efficiency and punctuality which this line has earned. Messrs. Alfred Holt, of Liverpool, subscribed to the original endowment fund of the Hong Kong University, and they have given most encouraging assistance to the Engineering Departments. They have granted free passages to the Chinese graduate-apprentices who obtained practical experience with engineering firms in Britain, and they have taken a personal interest in each one of the young graduates, assisting them on arrival in Britain.

In spite of up-to-date mechanical equipment a very large number of coolies, mostly from Swatow, are employed in handling cargo. They are strong and reliable, working often under Chinese stevedoring firms. For general cargo stevedorage in my time was charged about 22c. (say, 3d.) per ton weight, but no doubt wages have increased in more recent years.

An unlimited supply of fresh water can be taken on board direct from wharf mains at a cost of 55c. (say, about 8d.) per ton of 224 gallons. It is also possible to obtain pure water at the same rate if the vessel is lying at a buoy. The rate from a waterboat is 100 tons per hour per boat.

It is the proud boast of those engaged in the trade in Hong Kong that the discharge and handling of import cargoes as obtainable there is as good as any in the world. As much as 200 tons per hour has been handled with ease.

### OTHER SHIPPING LINES

There are many other well-known shipping firms whose vessels fly the Red Ensign as they come into the harbour of Hong Kong. It is of interest to note that one line, well known on the China coast, possessed a dozen ships in 1881, with tonnage varying from 650 to 1557 tons. In 1893 the fleet had increased in number to twenty-three, the average tonnage being about 1700. (That was a year when the British income tax was 7d.!) In 1915 the number was forty. To-day most of the British coasting vessels seem to be about 4000 tons.

There are a number of companies with ships engaged in the China coasting trade and under British register. The two or three most important lines are managed by British firms known in London, but there are lines owned and managed by Chinese who are British subjects. A Hong Kong University graduate (Chinese) is the superintendent marine engineer for one of the largest of the Chinese-owned shipping firms. About twenty years ago he worked as a graduate apprentice in the big dockyard where he now inspects steamers repaired there.

The most famous British lines of steamers from Europe and North America calling at Hong Kong are the P. & O. Steam Navigation Company, Ltd., Alfred Holt and Co., Ltd., British India Steam Navigation Company, Ltd., Canadian Pacific Steamship Company, Ltd., Glen Line, Ltd., Prince Line, Ltd., Bank Line, Ltd., Ben Line, Ltd., Ellerman and Bucknall, Ltd. Many of these ships are repaired in the Hong Kong dockyards, as are many of the vessels belonging to other nationals.

There are numerous foreign lines, whose ships, under normal conditions, call at Hong Kong. These include Japanese (N.Y.K., T.K.K., and O.S.K.), Dutch, Swedish, Norwegian, Danish, French, German, Italian, and Chinese.

An important section of the shipping trade of the Colony is concerned with numerous steamers that leave the wharves—especially the piers in the western end of Victoria—for ports up the South China rivers. There are also a very large number of junks engaged in distributing cargo to ports along the coast or places inland up the rivers. In recent years a large number of roads were built in South China; the effect of these (before the Japanese invasion) was to increase water-borne traffic.

Early in the twentieth century the British shipping companies in the Far East began to feel the effect of competition from the ships of other nations, those of Germany and Japan especially giving British owners a grievance, as those nations subsidised their ships. In spite of this handicap the Red Ensign could be seen all over the Far East. The Japanese invasion of China has been a misfortune for British firms.

My own impression of the trade in that part of the world is that there have been good times and bad times for the owners of British ships. There have been many wars and rebellions affecting the China trade. The neglect of some of the waterways, particularly that leading to Tientsin, by the Chinese authorities was a source of much annoyance to shipowners. But during the past century the trade went on and we may be confident that the Red Ensign will be seen on the China seas for many years to come.

Meantime, the Government in Hong Kong has the plans for a number of new wharves and various other harbour improvements recommended by the late Sir Maurice FitzMaurice as a basis for new works when the opportunity to put them in hand presents itself.

*(To be continued)*

# Alexander Morton and the Ejector Condenser

THE late Mr. Robert Bruce, who died in 1931, left behind the draft of some memoirs of a life which had brought him into contact with many eminent engineers. Amongst these papers his son, Mr. A. K. Bruce, has found these notes on Mr. Alexander Morton and his ejector condenser, and has been good enough to send them to us for publication. It will be remembered that the condenser was exploited by Gebrüder Körting, of Hanover, but it is not known whether or not they took a licence from Mr. Morton.

When one sits down with the intention of putting together the recollections of many years spent in the active exposition of improvements associated with the development of the mechanical engineering industry of this country, the category in which engine building is included must have a prior claim. In my early youth I was singularly attracted by machinery of all kinds, particularly locomotive engines, and so when it came about that I found myself, at the age of fifteen years, a pupil of the late Mr. Alexander Morton, of Glasgow, an engineer and mechanician of great brilliance, my whole interest was completely absorbed. There did not seem to be anything else that mattered beyond understanding the nature of the work set before me from time to time. Moreover, than Mr. Morton, a better instructor for an engineering student must have been hard to find.

Alexander Morton was the son of a Dundee watchmaker, and I have been told that, as a boy, he occasionally caused obstruction to traffic by reason of the assembly of carters who pulled up by the roadside, gazing at models of waterwheels with which, by the aid of the burn, the lad was experimenting. Before I became his pupil, Morton's outstanding mechanical talent had been devoted to the development of stationary engines, though for years previously to 1867—when I entered his service—he had also endeavoured to employ the principle of lateral action in order to effect the eduction of exhaust steam and incondensible gases from steam engines, thus suppressing a condensing chamber plus a reciprocating air pump, which latter device was patented by Henry Wood in 1759 and subsequently adopted by James Watt.

It was to Venturi, the Italian philosopher-priest, that Morton was indebted for much of his technical background, and while I do not know to what published records of the work of Venturi he had access, it was doubtless to a translation of the famous "Recherches Expérimentales sur le Principe de la Communication Latéral du mouvement dans les Fluides appliqué à l'Explication de Différens Phénomènes Hydrauliques." It may be of interest to note that this celebrated little treatise was published in 1797 during the Abbé Venturi's residence in Paris and before he became professor in the University of Pavia. Great as has been the honour paid to Giovanni Battista Venturi by those hydraulic engineers who have followed up his original work in this field, it may not be generally known that in the development of the ejector condenser Venturi was Morton's philosopher and guide.

Some years of patient experimental work preceded the attainment by Morton of a device in which the principle of lateral action was utilised in a most efficient manner, and this form of apparatus was afterwards aptly named (by Professor Rankine) an "Ejector Condenser." The Ejector Condenser need not now be described. It is known to most engineers and has been used for a variety of purposes not connected with steam engines. It should be stated, however, that the objective of Morton in this invention was to find a substitute for the air pump of Wood and the separate condenser of Watt, so that the kinetic energy in the exhaust steam delivered to the condensing medium would be sufficient to carry out and expel to the atmosphere the condensable and non-condensable vapour and gases which go to make up the back pressure against which the prime mover operates.

In the evidence which he gave against James Watt during the action Boulton and Watt *v.* Bull, Bramah contended that "no engine can be built with a condenser and without an air pump anything like so good as Newcomen's." Morton, seventy years later, managed the whole thing, and it was the realisation of this accomplishment which caused Professor Rankine to describe the ejector condenser as the most useful discovery made in the field of steam engineering since the time of Watt.

Financial stringency, as well as the absence of some of those personal characteristics needful in expounding new ideas to non-enthusiasts, operated to retard development. However, there were some leading engineers at that time, including Alexander Kirk, Walter M. Neilson, and Professor William Thompson (later Lord Kelvin), who early recognised the originality and utility of this invention, and within the same patent specification Morton had (by an original combination and proportion of nozzles) shown the way to very valuable improvement in the working of Giffard's injector, the effect of which was to eliminate, from that type of apparatus, the difficulties hitherto existing, due to the fact that its operation was sensitive to interruption. Trouble was frequently entailed when starting and at other times, priming and excessive jolting (on locomotives) being common causes.

While the advent of the ejector condenser made it possible to eliminate the separate jet condenser (or surface condenser) and reciprocating air pumps from the stationary engine, the use of the ejector condenser for sea service in marine engineering was not proceeded with after trials in three small vessels in 1869 and 1870–71. These trials proved unsatisfactory, due to the fact that where sea water had to be used for condensing by direct contact, it was impossible to conserve the resultant condensate for boiler feeding purposes.

The principle of lateral action was also, at about this time, employed for exhausting vacuum pans and for removing air and water (at starting) from the surface condensers of stationary engines and marine engines, as well as for drainage of works in railway tunnels.

In the case of a particular tunnel—the Fairlie tunnel on what was then the Glasgow and South-Western Railway—the actuating water was taken from a small adjacent waterfall. This installation of an ejector was an alternative to the employment of steam boilers and pumping plant, involving heavy cost in fuel, maintenance, and attendance. The site being comparatively remote, these items of expenditure and maintenance (a considerable concern to the contractors) were all avoided, the initial cost being confined to the lateral action apparatus, including seating and erection, there being no repairs and stand-by attendance, and no cost for fuel. The work of continuous drainage was most effectively performed, and represented a direct application in practice of the principles enunciated by Venturi.

Morton made a detailed and expensive investigation into the possibility of adapting his form of lateral action apparatus for discharging low-pressure steam direct to the boilers, with the idea that the contained latent heat might be conserved. After some years of work the attempt was abandoned, the conclusion reached being that the scheme could not be carried beyond the academic stage.

In the early eighteen-seventies, Mr. Morton, in a paper read before the Philosophical Society of Glasgow, gave an account of some original experiments with lateral action apparatus, showing how wide a range of pressure may be realised by small adjustments of the conoidal nozzles. R. D. Napier, James R. Napier, William Brownlie, and Professor Rankine were deeply interested in these experiments, and, as a matter of fact, this group of eminent engineers and physicists co-operated with much enthusiasm in laying down the principles and formulæ controlling the design and successful operation of this type of apparatus, which by this time was beginning to be prominently associated with steam prime movers. The personalities of the investigators and engineers whom I have named remain vividly in my recollection, though it is many years since the last of them passed away. I can testify that they were all extremely genial men, with strong individualities and remarkably pleasant manners, who went about their daily avocations taking obvious delight in their work.

As not infrequently happens in the case of inventors responsible for simple, if original and useful, creations, Morton was not permitted to work his invention unmolested. An action at law was raised in the Court of Session at Edinburgh, which, after a hearing continuing for six days, gave a unanimous verdict for Morton, who was plaintiff. In this case many leading engineers appeared to support the claims of Mr. Morton, amongst them being Professor Rankine, Sir William Thompson (later Lord Kelvin), Mr. Frederick Bramwell (later Sir Frederick Bramwell), Mr. William Hulse of Manchester, and others. With the latter gentleman I came, on this occasion, into close personal contact, and have very pleasant recollections of our intercourse.

As is not unusual, some of the grounds of defence were very flimsy and readily rebutted. One of them (common in such cases) was that the specification could not be understood by the ordinary mechanic. Morton's counsel considered it sufficient, in rebutting this allegation, to bring in the junior member of Morton's office staff, who at that time happened to be myself, though I was debarred the honour of thus appearing by the withdrawal of the defendant's contention.

An example of Morton's singular application in research was disclosed in a paper which he read before the Philosophical Society of Glasgow in 1876. This paper described certain experiments which he made on the "Maximum Elasticity and Density of Vapours," a subject previously dealt with, among others, by Regnault ("Memoires de l'Academie des Sciences," 1862), and Cagniard de la Tour ("Annales de Chimie et de Physique," Vol. XXI). Morton found that English translations of the account of de la Tour's experiments contained a persistent error. This erroneous translation had been adopted even by Faraday (who was still alive), and Morton, in his experiments with the same liquids, could not come near the temperatures stated in the translations. Tracing the matter back, he found that the thermometer used by de la Tour was graduated to the scale of Réaumur, whereas all the translations had assumed the scale of Centigrade. The error was equal to nearly 100 deg. Fah., and when the necessary correction was made, the experiments of de la Tour and of Morton gave approximately the same results with the same liquids.

Mention of this paper of Morton's reminds me that it was before the same society that Rankine, then Professor of Civil Engineering and Mechanics in the University of Glasgow, contributed his classic discourse "On the General Law of the Transformation of Energy." This was in 1853, when the philosopher was in his early thirties.

THE SUPPLY OF QUICKSILVER.—The war in the Mediterranean is hampering the distribution of mercury from the Spanish and Italian mines, and both South Africa and America are doing much research work to relieve the situation. South Africa, which requires some 70–80,000 lb. per annum for the gold mining industry, has an obvious incentive to discover and develop whatever occurrences of mercury ore may lie within the boundaries of the Union. Already there are indications of possible large-scale production of this essential metal from cinnabar, which is the principal ore of mercury.

# Air Force Targets in Germany

No. XVII

(*Continued from page 111, February 14th*)

LUDWIGSHAFEN-AM-RHEIN

IN our previous article we dealt with the city and port of Mannheim, and described its industrial development, the port and its railway connections and the industries which have made it famous. In the present article we propose to describe some of the industries of the adjoining town of Ludwigshafen-am-Rhein, which is situated on the left bank of the River Rhine and is connected to Mannheim by the double road and railway bridge, illustrated in our previous article. Ludwigshafen and its immediate surroundings have been subjected to more than sixteen attacks by the bombers of the Royal Air Force, and they have been mainly concerned with the two large chemical works of the Badische Anilin-und Soda-Fabrik, whose factories at Ludwigshafen and Oppau are both situated on the left bank of the Rhine, a little to the north of the main city of Mannheim and almost opposite the industrial harbour and the industrial centre of Mannheim-Waldhof, which we illustrated in the previous issue. These two chemical works, with their housing colonies, form almost a town in themselves. A feature of the lay-out is a long river front, which stretches along the left bank for close upon 5½ kiloms., or over 3½ miles. This bank is provided with loading and unloading berths with crane equipment and a network of lines which serve the works. The two factories are principally engaged in the manufacture of dyestuffs, acids and alkali products, and the production at Oppau of nitrogen from the air which is combined with hydrogen to form ammonia and forms the basis of several artificial manures and nitrate salts.

SHUNTING YARD AT LUDWIGSHAFEN AND OPPAU WORKS

### ORIGIN AND GROWTH OF THE FIRM

The business of the Badische Anilin-und Soda-Fabrik now forms part of the I.G. Farben-industrie Aktiengesellschaft.

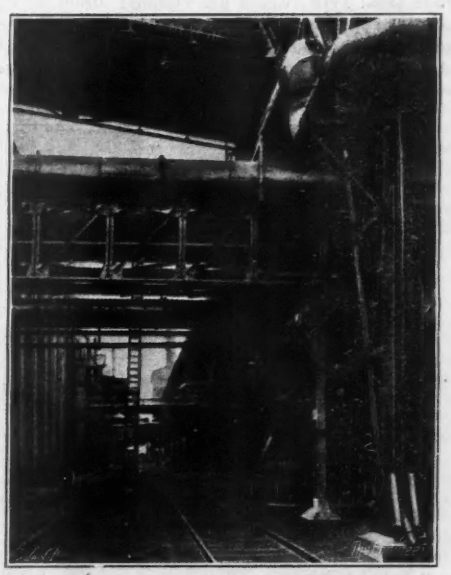
In describing the early development of Mannheim we made reference to the founding in 1861 of the chemical business of Dyckerhoff Clemm and Co., which was greatly developed during the last half of the nineteenth century and for some time was operated under the name of Sonntag, Engelhorn and Clemm. The necessity of closer relations in the production of aniline dyes and organic products led to an extension of the business of the firm, and about 1865 the new undertaking was incorporated under the name of the Badische Anilin-und Soda-Fabrik. The new factory was constructed at Ludwigshafen, which had at that time only a few relatively unimportant manufacturing concerns and was little more than a village. For some years the new company made, among its principal products, aniline dyes, soda, sulphuric acid, nitric acid, and other chemicals. In 1870 the manufacture of alizarine dyes was begun, and in 1897 the company introduced synthetic indigo, and vat and indanthrene dyestuffs. At the beginning of the twentieth century the Badische works, in conjunction with the factories of the Beyer and Agfa concerns, and the Hydroelectric Nitrogen Company in Norway, began to utilise nitrogen from the air. About 1910 the ammonia synthesis process of the I.G. Farbenindustrie Aktiengesellschaft, known as the Haber-Bosch ammonia process, was introduced, and the Badische Company withdrew from the Norwegian agreement and erected new works at Oppau to the north of Ludwigshafen. So great became the demand for nitrogen products, especially after the declaration of war in August, 1914, that it was decided to erect new ammonia works at Merseburg, now known as the Leuna Works, taking advantage of the large lignite deposits in Central Germany as a cheap source of power. These works are among some of the largest industrial plants in the world, and in our issue of November 8th, 1940, we described the process at the Leuna factory.

GAS ENGINE-DRIVEN GENERATOR PLANT

ABSORPTION TOWERS AT NITRIC ACID PLANT

### THE OPPAU AMMONIA FACTORY

In general design the plant at Oppau is not very different from that at Merseburg as regards the ammonia side of the plant. In the Haber-Bosch process an aqueous solution of ammonia is produced by combining directly nitrogen gas obtained from the air with hydrogen gas obtained from gas producer plant. The reaction takes place in special contact ovens in the presence of a catalyst at a pressure of 200 atmospheres, and at a temperature of between 500 deg. and 600 deg. Cent. The process was only made workable after many laboratory and small-scale plant tests, and its practical application having been demonstrated, it was decided to design the Oppau factory for an output of about 100,000 tons of fixed nitrogen per year. The Merseburg plant is of larger capacity with an output of 500,000 tons. The Oppau factory covers an area of 494 acres and comprises a group of 400 to 600 buildings, which house the chief manufacturing units and make provision for the storage and shipment of the completed fertilisers.



ROADWAY THROUGH THE GAS PLANT AT OPPAU

The works have their own railway yard, and that for the Ludwigshafen and Oppau works is shown herewith. The railway track extends for more than 20 miles and some 1500 railway wagons are shunted each day. On the banks of the Rhine there are several coal discharging plants, which take the coal from the barges and transfer it to producer plants and power stations in the works. The works use steam, gas and electricity as sources of power. Brown coal or lignite briquettes are also used in the gas producer plants. The coal and coke which are needed come from the Ruhr district and the lignite is also shipped to the works. Another important item is the supply of water, and at the Oppau works some 21·2 to 24·7 million cubic feet of water are taken from the Rhine each day and are purified at the works by treatment in sand filter beds and special purifying plants. Most of this water is needed for cooling purposes, and the rest serves for washing the carbon dioxide from the gas mixture, for steam raising, and for solvent purposes. The used water is again purified and is then returned to the river through underground channels.

In the gas plant coke-fired generators are employed, and either gas rich in nitrogen can be made by passing air through the generators or water gas rich in hydrogen by passing steam and air. The gases so obtained are passed through scrubbers and are stored in gasholders. One of the largest gasholders at Oppau has a designed capacity of 1¾ million cubic feet. Yet the demand for gas is so great that an amount equal to the contents of this gasholder are

used in less than one hour. As in the fuel processes, it is necessary to remove sulphur compounds from the gases before they are passed to the catalyst. After the sulphur has been removed the carbon monoxide present is converted into carbon dioxide by interaction with steam in the presence of another catalyst, and at the same time hydrogen is liberated. A feature of the gas plant section of the works is the network of pipes, which are carried on overhead bridges and run along the sides of the roadways. One of our engravings shows a typical roadway through the gas plant in the Oppau works.

Gas is also utilised to drive gas engines of the horizontal type, which are coupled direct to fly-wheel type alternators. A view in one of the gas engine-driven power stations is given herewith. Another important section of the works is the gas compressing plant. The mixture to be compressed

TYPICAL BATTERY OF CONTACT OVENS

consists of hydrogen, nitrogen and carbon dioxide, and it is freed from its carbon dioxide content by treatment with water at a pressure of about 25 atmospheres. The carbon dioxide so dissolved is again freed by reducing the pressure and is used in the manufacture of ammonia sulphate. The gases which have been freed from carbon dioxide are again compressed in reciprocating compressors to a pressure of 200 atmospheres, and while at this pressure any traces of carbon monoxide and any other impurities which may remain are removed from the gas mixture by contact with a copper salt solution. The resultant mixture consists of hydrogen and nitrogen. In order to produce ammonia it is necessary to arrange that the hydrogen and nitrogen are present in the mixture in the proportion of three to one. To do this, pure nitrogen is added, which is produced by liquefying air in a Linde plant. The highly compressed gas now reaches the contact ovens, of which we show a typical battery. In these ovens at high pressure and temperature and in contact with the catalyst a partial combination of the gases to form ammonia occurs. All the vessels are vertical and are made with thick walls. They are housed in specially reinforced chambers, which are kept open in order to prevent any accumulation of explosive gas mixtures. The ovens are erected in a tall steel building and the valves and instruments needed for the control of the process are arranged outside the oven chambers. Within the ovens the gas mixture is continuously circulated by large pumps and the ammonia is washed out by water, fresh supplies of hydrogen and nitrogen being added. The ammonia solution obtained is about 25 per cent. in strength and is stored in large reservoirs and forms the starting point for the manufacture of the various fertilisers.

### FERTILISER MANUFACTURE

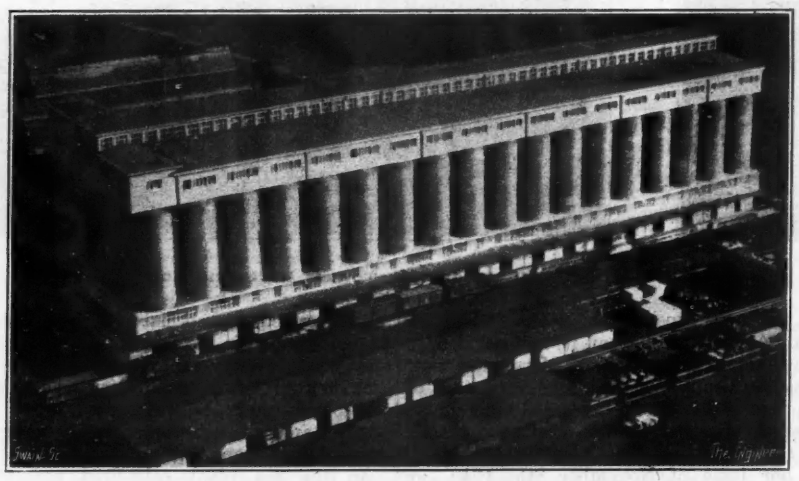
The two principal fertilisers are ammonia sulphate and calcium nitrate. The sulphate of ammonia is produced by combining ammonia with the sulphuric acid constituent of gypsum or calcium sulphate, the supply of gypsum being obtained from quarries which are situated in the neighbouring Neckar valley. At these quarries the rock gypsum is crushed and is delivered to the fertiliser works in covered wagons. On arrival at the factory it is further ground to form a fine meal. The gypsum meal is then churned with a solution of ammonium carbonate, which is prepared by passing carbon dioxide through an aqueous ammonia solution. The gypsum and ammonium carbonate interact to form a solution of ammonia sulphate and carbonate of lime. The next process is to filter off the lime sludge and to evaporate the resulting ammonium sulphate to small bulk, after which the crystals are separated out in large centrifugal machines. The carbon dioxide required for this reaction is a by-product of the gas synthesis process. Should chloride of ammonia be required, it is only necessary to utilise ordinary rock salt as the source of hydrochloric acid.

In order to make the nitrate salts, ammonia is burned to form nitric oxide, in the presence of a catalyst, the combustion taking place in large ovens built of brick, into which a mixture of ammonia and air is introduced, and passed through trays of gauze, upon which the catalyst is spread. The nitrous gases which are produced in the ovens are pumped through large granite absorption towers and nitric acid is formed. We show a group of these absorption towers at Oppau in the accompanying engraving.

If the nitric acid so obtained is neutralised by soda, which is manufactured at the Ludwigshafen works, then nitrate of soda is formed. Another commercial fertiliser is calcium nitrate, which is made by neutralising nitric acid with limestone. For the carrying out of this process nitric acid, limestone and burnt lime are required. The limestone is first dissolved in the nitric acid and the solution is then completely neutralised by the addition of milk of lime. After filtration has taken place the clear liquid is evaporated and is put into drums with 5 per cent. of nitrate of ammonia. This solution, which is still warm, is then dried by spraying it with compressed air, thereby producing white nitrate of lime or the commercial calcium nitrate which is used as a fertiliser.

For the supply of plant foods other than those containing nitrogen other compounds containing phosphoric acid and potash are made.

An interesting section of the plant is the machinery which is used to transfer the fertiliser from the point at which it is made to the storage silos. This machinery eliminates practically all manual labour. The largest silo at Oppau has a designed capacity of 55,000 tons. But it is small compared with one at Leuna, which holds 250,000 tons. We illustrate in our last engraving a calcium nitrate silo at the Oppau factory.



CALCIUM NITRATE SILO AT OPPAU WORKS

# Government Trading in War*

No. II

(*Continued from page 113, February 14th*)

### CONCLUSIONS AND SUMMARY OF RECOMMENDATIONS

AS the result of their survey, the Sub-Committee have reached certain general conclusions which are set out here, together with a summary of such other recommendations as have been made in the text of the report. In the forefront of their conclusions they would place their recognition of the vital part which sound principles of contract procedure must play in the efficient and economical provision of war supplies, and of the need for strengthening the independence of contracts branches so that they have both the information, the staff, and the power to carry out to the full their duty of securing economy in Government buying. As one means of avoiding ambiguity and waste of time in negotiations, the Sub-Committee recommend that an agreed list of definitions of the technical terms used in such negotiations should be drawn up and published.

(a) *Types of Contract and Methods of Costing.*—The Sub-Committee recognise that there is no single form of contract which will meet every case. Where special circumstances arise, such as the fact that a particular firm is highly efficient and has every indirect inducement to retain its economic efficiency, and better results are likely to be had by the use of an apparently less efficient form of contract, there should be no barrier to making such an agreement; but the Sub-Committee recommend that the following rules should be generally applied, and that proposals to depart from them should be subjected to special scrutiny by the Treasury:—

(i) Cost plus contracts should not be made for any work or product which is not novel in character, and should then only be made for the experimental phase, when even a maximum price cannot be fixed, as a means of arriving at an estimate of what continued or straight-run production is likely to cost. There may, however, be a few wholly exceptional cases where cost plus methods must be condoned on grounds of extreme urgency, but this only applies to work which it is essential to begin and to complete within a matter of days. Where the nature of the work is such that completion within a very short period is impossible, the cost plus method is more likely to delay than to expedite delivery, and is certain to increase costs.

(ii) Maximum price contracts may be necessary when enough experience has not already been gained to arrive at a closer estimate, and whenever possible they should be associated with a target figure below the maximum.

(iii) When a target is used, sufficient inducement, direct or indirect, should be given to the contractor to effect savings. The real use of both these methods is as a prelude to the fixing of a fair price for future contracts. They are expedients to cover a period during which information on costs of production can be collected and the difficulties of the less efficient firms be detected and overcome.

(iv) Apart from these special circumstances, every effort should be made to place contracts on a fixed price basis, and to this end full use should be made of data derived from previous experience, the examination where possible of market prices, and the results of cost investigation.

(v) In applying competitive tendering, regard should be paid to idle capacity and to the question whether this is the quickest and most efficient method of arriving at a fair fixed price. Otherwise, reliance should be placed on direct agreements based on full cost estimation. In particular, far greater use should be made of technical costing as the basis for future contracts placed by the Ministry of Supply.

*From the Fourth Report of the Select Committee on National Expenditure. H.M. Stationery Office Price 9d.

(vi) Post costing should be recognised as a means of providing information leading to fixed prices based on technical costing. Though the right to ascertain actual costs, even in some fixed price contracts, should be preserved, post costing by departmental accountants should be applied in detail only to those contracts which it is essential to cost for informative purposes and to others at random as circumstances and time permit—see (iii) below.

(b) *The Examination of Costs.*—The Sub-Committee recommend :—

(i) That closer scrutiny should be given by Departments to the costs allowed for labour on costed contracts with a view to securing that it shall be employed in the most efficient manner.

(ii) That, to secure a comparison of the ascertained costs of different firms greater uniformity in methods of allocating overheads to particular work should be adopted within groups of firms engaged on similar work under similar conditions ; that a clear and agreed decision on allowable overheads should be reached so that contractors understand their obligations before work is begun ; and that an *ad hoc* committee be appointed by the Treasury to consider the whole treatment of overhead costs.

(iii) That the systems of cost accounting already in use by contracting firms should be studied, and efforts should be made in the case of groups of industries to agree upon modifications with a view to reducing departmental costing and when possible accepting the firm's figures as certified by auditors, but subject to departmental "spot checks" ; that departmental costing methods should be simplified and as far as possible standardised ; that cost examinations should be made at the earliest possible time so as to accelerate both payment and the provision of information ; and that duplication of costing of the same firm by different Departments should be stopped at once.

(iv) That greater use should be made of current costings by getting periodical returns of the figures taken out by firms during production, or that "snap" audits might be taken before completion so as to provide early information for the fixing of future prices ; and that where applicable the method of process costing, as opposed to unit costing, should be used.

(v) That on the information received through the Progress, Area, and Costings organisations, lists of contractors graded in accordance with the quality of their work should be drawn up to guide the Contracts branch in the placing of further orders.

(c) *Profits.*—The Sub-Committee recommend :—

That rates of profit should be related to capital employed ; and that some degree of uniformity is highly desirable ; but since a simple fixed rate is hardly feasible, agreements to cover particular industries should be encouraged, though some flexibility should be retained to offer special incentives for special efforts.

(d) *Sub-Contracting and the Employment of Small Firms.*—The Sub-Committee attach great importance to the fullest use being made of the capacity of small firms, and they therefore welcome the work of the new Area Boards. They recommend :—

(i) That the use of the "parent firm" and "embodiment loan" schemes should be extended.

(ii) That the question of credit facilities should receive further attention ; that all payments due should be sanctioned and made without delay ; and that where final payments cannot be made, payments on account should be sanctioned as early as possible.

(iii) That the Treasury should give immediate attention to the question of the profits allowable to the main contractor on sub-contracted work ; and that the responsibility for "progressing" sub-contracted work should be clearly fixed, either on the main contractor or on the Progress organisation.

(e) *Departmental Organisation.*—The Sub-Committee again draw attention to the difficulties that, under war conditions, spring from the autonomy of the separate Departments, which are jointly concerned in what must be regarded as a single undertaking. The problem goes deeper than the mere provision of liaison facilities and involves constitutional questions which are not within the competence of the Sub-Committee. But it is within their scope to proffer any constructive suggestions which they hope may conduce to greater efficiency and economy within the existing framework. They do not forget that what may be readily criticised may not be so easily corrected. For instance, the need for the avoidance of delays is obvious ; but the resultant difficulties may not always be appreciated by those who have not experienced them and who are intent on their own problems. This applies particularly to the putting in of demands and to the placing of orders. If, on the one hand, the overloading of particular firms and, on the other, gaps in production are to be prevented, it must be impressed on ordering branches that information in terms of approximate quantities of stores should reach the Supply and Contracts branches in time to allow of careful allocation and negotiation. It is equally important that this information should reach the contractor before the completion of his current orders so that he may plan accordingly. With this type of consideration in mind, departmental organisations should be carefully examined in order to secure the maximum co-ordination in future planning, and in addition standards of inspection need a systematic and regular overhaul.

The Sub-Committee further recommend :—

(i) That arrangements should be made for Intelligence and Statistical branches to collect information and to analyse and compare the figures received from costing and other sources so as to provide contracts officers as early as possible with a sound basis for their negotiations and criticisms.

(ii) That contract procedure should be brought under a more direct and unified control with sufficient authority to overcome departmental prejudices ; that the Contracts Co-ordinating Committee, or a sub-committee appointed *ad hoc*, should, with the help of industrial representatives, consider the greater standardisation of general conditions of contract and draw up common form clauses which should not be varied in individual contracts without the authority of the permanent chairman of the main committee ; that the permanent chairman should be free to devote his entire time to matters directly connected with the work of the Contracts Co-ordinating Committee ; and that the composition of the committee should be strengthened by the addition of officers who could study the market and the trade information available.

(iii) That the spheres of Supply and Contracts branches of the Admiralty, the Ministry of Aircraft Production and the Ministry of Supply should be reconsidered with a view to securing a more rational distribution of functions based on the general principle of reducing the number of departments dealing with the same industry or firm ; that the purchase of general stores, clothing and personal equipment should be the function of a separate new branch ; and that, with the exceptions noted, all constructional building, whether for Civil or Service Departments, should in future be the responsibility of the Ministry of Works and Buildings.

## South African Engineering Notes

*(By our South African Correspondent)*

### Iscor Steel Works

DURING the year 1939–40 the production of steel ingots at "Iscor" works totalled 352,292 tons, an increase of some 8000 tons compared with the preceding year. The output of the heavy mill, which includes billets and sheet bars for re-rolling in the works own light mill and sheet works, reached a record total of 285,021 tons. The production in the light mill increased from 38,991 tons in 1938–39 to 43,280 tons in 1939–40, and in the case of the sheet works the production of sheets and light plates increased from 57,612 to 74,820 tons. These are records.

It was decided last year to increase the steel output capacity at Iscor Works by installing converter plant to operate in conjunction with the open-hearth furnaces, under the "duplex" process, and to proceed simultaneously with the erection of a second battery of coke ovens, these being required to maintain full production in the two blast-furnaces. This additional plant will increase the steel ingot output capacity by about 100,000 tons per annum. It had been hoped to complete these extensions by the first quarter of 1941, but the war has caused delays in deliveries of plant and equipment from overseas, and it may be three or four months later before the whole of this new plant can be brought into production. It has since been decided to proceed with the construction of a third blast-furnace at Pretoria, partly as a standby to the two existing blast-furnaces and partly to increase the pig iron output which will, in turn, increase the steel ingot capacity by a further 150,000 tons per annum. Work on this furnace is already in hand, and it will probably take over twelve months to complete. The output capacity of the local steel industry under normal conditions represents about one-third of South Africa's total requirements of steel products, and in view of the scope existing for the expansion of the steel industry in the Union the question of still further increasing local steel production, and of extending the range of steel products manufactured in the Union, has been under consideration. The developments contemplated include further extensions at the works (including the erection at Iscor works of an up-to-date wire works for the production of all commercial grades of steel wire) and the erection of a new steel works in the neighbourhood of Vereeniging. War conditions have delayed action, but the planning of the various schemes and considerations of lay-out, &c., are proceeding and the work will be carried out in convenient stages and to such extent as may from time to time be found to be practicable.

At the annual meeting of shareholders of the corporation the chairman dealt with the effect of the war upon the steel position in South Africa, and pointed out that the country normally imported about two-thirds of its requirements of steel products. When supplies from overseas became difficult to obtain the corporation introduced rationing arrangements. It also took steps to arrange imports from Australia and imports from Canada and America were increased. It has been necessary to import steel billets for re-rolling and reprocessing in South Africa. These cost substantially more than locally made billets and so a temporary surcharge has had to be introduced. The output of Iscor has been temporarily reduced by the necessity for relining one of the two blast-furnaces.

### Industry and the War

A bright picture of the labour and industrial position in South Africa is furnished by the report for 1939 of the Secretary of Labour just published. "A further marked improvement in the economic conditions in the Union, as well as considerably increased industrial activity, was reflected during the major portion of the year 1939," he states. The unsettled international situation appeared to make almost negligible inroads on the wave of prosperity which has been a feature of the Union's economic progress during the past few years. Only with the actual outbreak of hostilities was there the inevitable sign of financial stringency and a curtailment in many directions in business and industrial enterprise. In many industries the war decline appears to have been only a temporary phase, and normal conditions were reported before the close of the year. Until September, in the majority of the more important industrial undertakings, practically all the skilled labour available was employed, and in secondary industries there was likewise consistent development, while the increase in gold-mining activities had the natural effect of stimulating the general industrial position, thus affording increased avenues of employment, particularly for skilled workers.

### Union Industries Generally Busy

Reports to hand from the big industrial centres are very satisfactory, and further progress is considered to be likely. Marine engineering shops are fully employed. All the steel-producing plants are working to capacity, and though they are busy on war orders for which they were not fully equipped, they have been able to maintain a good output and also execute all orders from their normal customers. The result is shown by the excellent balance sheets issued and good dividends are being declared. The general level of activity in secondary industries in the Union during recent weeks has risen slightly, and it is expected that the improvement will be maintained. The country's ports have been busier than ever handling new records in ships and tonnages. The railways have broken all previous records in weekly earnings. The number of ships calling at Table Bay has risen from 1618 in 1939 to 2053 in 1940, with a corresponding rise in tonnage, giving a complete reply to the German boast that they have blockaded British shipping off the seas.

### Big Loan for Electricity Expansion

A big Electricity Supply Commission loan has just been placed on the market. The amount of the loan is £1,500,000. Its first purpose is to finance several big schemes. The Klip power station is nearing completion and the Vaal power station is expected to be in operation in 1942. Extension schemes in other parts of the country are also to be undertaken. In Natal many new customers are expected to be connected to the Commission's grid. In the Cape the new line from Worcester to Wellington, *viâ* Bain's Kloof, is to be constructed. This will extend the Commission's activity into a new important area.

### Union Supplies Wavell's Army

Among interesting facts supplied by Dr. H. J. van der Bijl recently was one describing how a complete automatic shell-forging plant was built and brought into operation in South Africa in exactly six months, though England quoted eighteen months as the shortest delivery period. One plant is now turning out thousands of shells. Dr. van der Bijl, who is the Director-General of War Supplies, also stated that after South African engineers started on the production of a howitzer, progress was so rapid that seven and a half months later the howitzer was tested and the gun was found satisfactory. The United States had quoted twelve months for the production of the same type of gun.

Dr. van der Bijl also revealed that large numbers of armoured cars of South African steel and make have been supplied to the British Army in Egypt, and the report of their behaviour in action has been most encouraging. The South African engineers are engaged in efforts to improve on the model. Dr. van der Bijl foretells a great industrial development of South Africa after the war. He visualises the Union as being self-supporting, even building her own merchant ships and locomotives and all varieties of machines.

### Rhodesia's Industries

The value of the net output of the secondary industries in Southern Rhodesia last year was £4,363,000, a little more than half of the gross agricultural output of £3,700,000 in 1938–39, according to the first report on the Census of Industrial Production in 1938 and 1939. The net output and the value of the gross output both increased by about 10 per cent. in 1939, as compared with 1938. Secondary industries provided a direct market for £4,609,000 of fuel and materials in 1938, and £4,165,000 in 1939, and an indirect market in the total value of salaries and wages expended of £2,685,000 in 1939, as compared with £2,457,000 in 1938. Of the numbers employed in 1939, 5132 were Europeans compared with 37,795 other races. The numbers of Europeans and natives engaged in agriculture in 1939 were 47,111 and 93,636 respectively.

# The Engineer

*FEBRUARY 21, 1941*

VOL. CLXXI No. 4441


## Contents


THE ENGINEER, February 21st, 1941 PAGE

A SEVEN-DAY JOURNAL ... 123

LEADING ARTICLES—
THE ENGINEER AND DESERT WARFARE ... 130
SCIENCE AND SECRECY ... 130

SPECIAL ARTICLES—
AIR FORCE TARGETS IN GERMANY. No. XVII. (Illus.) ... 127
ALEXANDER MORTON AND THE EJECTOR CONDENSER ... 126
THE HONG KONG CENTENARY AND APPLIED SCIENCE. No. III. (Illus.) ... 124

COMPACT GALVANOMETER SCALE UNIT. (Illus.) ... 135
ERECTION OF HOWRAH BRIDGE. (Illus.) ... 134
GOVERNMENT TRADING IN WAR. No. II ... 128
SCIENCE AND THE STATE ... 134
SHIP OF THE FUTURE ... 136

LETTERS TO THE EDITOR—
PEACE AIMS ... 131
COSTS AND WAR CONTRACTS ... 133
LOCATING PLUGS ... 133

OBITUARY—
KENNETH FRASER ... 131
EDWARD BROUGH TAYLOR ... 131

NEWS AND NOTES—
AMERICAN ENGINEERING NEWS ... 133
BRITISH STANDARDS INSTITUTION ... 137
FORTHCOMING ENGAGEMENTS ... 138
MARKETS, NOTES AND NEWS ... 137
NOTES AND MEMORANDA ... 138
SIXTY YEARS AGO ... 133
SOUTH AFRICAN ENGINEERING NOTES ... 129



**NOTICES TO READERS**

**PAPER SUPPLIES**

**With a view to the conservation of paper, readers are advised, in the interests of all concerned, to place a regular order for THE ENGINEER with their newsagent or direct with the Publisher.**

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *For Subscription rates, see page 2 of Advertisements.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

CHANGES OF ADDRESS

*** *Will Subscribers please note that in all advices regarding changes of address it is necessary to have* **both the old and new address,** *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

**Postal Address: "The Engineer," 28, Essex Street, Strand, London, W.C.2.**

**Telegraphic Address: "Engineer Newspaper, Estrand, London." Telephone: CENtral 6565 (10 lines).**


## THE ENGINEER AND DESERT WARFARE

IT is only now, after many months, that the merited recognition is being given to those who have designed and made the weapons with which the war on land is being and is to be fought out. That is no doubt due to the fact that until General Wavell opened his campaign in Libya our mechanised forces had the opportunity to show neither their mettle nor the high qualities of the material with which engineers had supplied them. We take our Navy for granted. It never occurs to anyone that in any respect it is lower than the best. With complete confidence, we expect it to do what it has always done. In the air, when the war began, we could not have the same calm certainty of success. We had no experience of modern air fighting; that we were up against an enemy who could outnumber us many times, and whose designers and makers of aircraft were known to be of the first rank, was common knowledge. What we did not know was whether our machines were the equal of German machines in fighting qualities. The battles of June and September brought a feeling of relief, coupled with exultation. Our fears, it was shown, were groundless. In men and machines we were better than the enemy; we could do more than hold our own. From that time onwards attention has been riveted ever more closely on the Air Force, and the exploits of it and of the Navy have almost monopolised the field of praise. Now, however, that the mechanised army has demonstrated to the world the things of which it is capable, it is fair that those who have laboured incessantly for years upon years to bring it to perfection should be awarded their meed of praise.

It is too often assumed that weapons of war, even the most modern, are just taken off the shelves of the Army and Navy stores. Few people stop to consider what marvels of materials and ingenuity, of thought, and of skill they are. There is not one of them but has been evolved only after prolonged and strenuous tests. One and all bring into use the most recent developments of science and engineering. They are the embodiment of the thought and experience of many minds and the skill of many hands, the product of a team of engineers working together over a long period of years. Consider, as a single example, the heavy tractor engine for war work. Since the Boer War it has passed through many stages of development in the endeavour to improve its cross-country performance. The trials to which it has been subjected have not been haphazard. A single purpose has been kept ever in view, and all efforts have been directed towards it. That purpose is to enable troops to be moved anywhere for tactical warfare without reference to roads. Success has been achieved by the principle of the distributed load; the same principle which carried the Stephensons across Chat Moss. With the help of balloon tyres and the multiple wheel drive, the pressure per square inch of tyre area on the ground has been brought to such a low figure that almost any type of ground, desert sand included, may be negotiated. The only serious check on development was the lack of money for experimental work. We were so busy about social reforms that we grudged every penny spent on preparation for war. In such circumstances, some doubt about the perfection of our products was understandable, and it is with a relief equal to that which the Air Force has given us that accounts of the prodigious feats of transportation in Libya and East Africa have been followed. For many years Army officers have been quietly studying the peculiar problems that desert transportation presents. The result of their work is seen in the events of to-day. Every improvement that they called for has been met by engineers, and it may be said now, in the light of recent experience, that we have in technical equipment an army worthy of its great leaders and indomitable men. Engineers may be justly proud of the outcome of their labours and gratified to know that their products have not let down Generals whose daring called for the limit of technical endurance.

We have taken but a single example because it happens to be the one of all that is attracting attention at the moment. But in a hundred other directions the same sort of development is going on continuously. We may all take heart from the brilliant success of mechanical transport in the calm confidence that, despite much criticism and condemnation, our advances in other directions have been equally effective. Here there is no case of allotting praise to individuals. It is the engineering profession as a whole that merits it, for manufacturers, civil engineers, and the Service establishments have all collaborated, all given their quota of help. The unthinking public rarely gives credit to those who provide its comforts, luxuries, and necessities. What the engineer does is just taken for granted, and the sweat of his brow and his sleepless nights are left unacknowledged. But with such a brilliant demonstration of his work as that afforded by Wavell's campaign, even the most thoughtless must take his hat off to him.

### Science and Secrecy

A FEW weeks ago Dr. A. V. Hill, F.R.S. and Member of Parliament, addressed the Parliamentary and Scientific Committee of the House of Commons. The title of his address was "Science, National and International, and the Basis of Co-operation." It might have been delivered anywhere, but there was assuredly no more fitting place than the House of Commons. Dr. Hill is a physiologist of renown, a professor, and Secretary of the Royal Society. His work has brought him into contact with governmental research and research workers. He is in a position to know what he is talking about, holds definite ideas, and expresses them with lucidity. Much of his address concerned itself with scientific organisations, the internationality of science, and kindred subjects. But a large part of it was a lively revelation of the dangers that will be encountered if the State attempts to control, or, even worse, administer, science and scientific research. This section we have thought it well worth while to reproduce, not alone for its own outstanding merit, but because we feel it should reach a far larger public than a few handfuls of politicians.

Whilst admitting the importance, indeed the necessity, of scientific organisation within the framework of Government and of financial support by the State, Dr. Hill propounds five dangers that threaten the independence and integrity of science if it ever becomes, as it has already done in some other countries, wholly subservient to the State. The first of these is the condition of "stagnation and complacency" which develops in any scientific department cut off from outside criticism and ideas; "the reduction of science to official routine can be a real menace." The second is the danger that science will be planned by administrators instead of by the workers themselves. The third, that teaching may be separated from research. The fourth, that the influence and prestige of independent scientific bodies may decrease; and the last that, since he who pays the piper calls the tune, "research may be required to be devoted primarily to objects which the politician or the civil servant regard for the moment as of national importance; or even—as in Germany and the Soviet Union—to bolstering up theories which the official philosophy of the State prescribes." To none of these five dangers did Dr. Hill pay so much attention as to the first. His criticism of the scientific research departments of the Defence Services is outspoken and severe; that it can be successfully challenged is open to great doubt. He points out that, owing to the secret nature of their work, the Government scientists are segregated from those working in the freer atmosphere of the universities. They cannot discuss their work with fellow scientists or take part in public debates. This lack of contact with others leads to stagnation and complacency. "Consequently in war," says Dr. Hill, "those who direct these establishments are often people who have arrived at their position by seniority and long service, during which they have been largely isolated from the ideas and criticism of current scientific thought; it has been difficult for them not to become officials rather than working scientists. When an emergency occurs, as at present, numbers of able men come in, but to posts in which they can exert relatively little influence, and their ability and imagination may for long be imperfectly used." To check this danger—and that it is a real one cannot be denied—Dr. Hill suggests that some kind of advisory council, on which independent scientific men would be included, should be introduced into each department or organisation, and that in ordinary times there should be a regular interchange of personnel between the Government research departments and the universities and "other independent institutions in which research is carried on." With regard to the first of these proposals, Dr. Hill's own remarks should be read; they are too long to quote here. But as a gloss on them we venture the opinion that unless the advisory council is selected with catholicity it will fail of its purpose. It should not be composed only of eminent persons selected from a close borough, but, in the case of engineering research, the leading institutions should be asked to nominate members of it. Furthermore, it ought to be a fairly fluid body; it ought not to be rigid and unchangeable, but be subject to modifications to suit particular circumstances. Otherwise we shall all be asking, *Quis custodiet ipsos custodes?* The advisory council itself will become narrow and will find itself subservient to or infected by the departmental spirit. With regard to the second proposal, we fear with Dr. Hill that it will be opposed tooth and nail, but that does not mean that it is not sound and workmanlike.

From this all too brief review, it will be seen that

the address opened up a subject which will almost certainly have to be tackled in the reformed world which we are promised after the war, but which is of great moment at the present time. For many years the practice of official secrecy has been on the increase. There was a time when there were much fewer, if any, restrictions. Ships and guns were described openly at meetings of the learned societies and were freely discussed and criticised. There was no hierarchy working behind closed doors and blackened windows. Everyone and anyone could have his say on the products of a Government Department. When the "Dreadnought" was built within barricades—through which foreign Powers peeped—all that was changed. The hush-hush policy was introduced, and rapidly developed. Criticism died because it had nothing to feed upon, and with it died the value of independent thought. It may be that secrecy is the best policy; that it is more important to conceal from a potential enemy what you are up to than to get the advantage of free opinion. But if it is so, then the necessity to ensure that the hierarchy is not becoming petrified within its own temples is a very positive one. Dr. Hill revealed the dangers; it is to be hoped that the Members of Parliament who heard him took note of his words.

## Obituary

### KENNETH FRASER

THE non-ferrous metals industry has sustained a severe loss by the death on Monday last at his home, Tregullow, Oakwood, Leeds, of Kenneth Fraser, the vice-chairman and managing director of the Yorkshire Copper Works, Ltd., of Leeds. Kenneth Fraser was born at Stockton-on-Tees in 1874, and received his education at the Quaker School in that town. On leaving school he began his training for a commercial career with the Stockton Malleable Iron Company, Ltd., which, at a later date, became part of the South Durham Iron and Steel Company, Ltd. Some years later, at the invitation of Mr. Neville Chamberlain, the late Prime Minister, he went to Birmingham to take part in the management of Elliott's Metal Company at Selly Oak, Birmingham. After spending a period in South Wales he took up his appointment in 1907 with the Yorkshire Copper Works, Ltd. He travelled widely and knew intimately both North and South America and the Continent of Europe. Apart from his local interests, Mr. Fraser found time to take part in national affairs, and he was vice-president of the Federation of British Industries, and chairman of the Leeds and District Branch of the Federation. He was a Fellow of the Royal Society of Arts, a Freeman of the City of London, and an associate of the Institution of Naval Architects. During the war period he has been in constant touch with Ministerial and Service advisers, and he was chairman of the Leeds War Savings Committee and the Leeds War Weapons Campaign. He gave freely of his best to all these efforts, and would take no rest. During recent months he showed signs of exhaustion and collapsed at his home on Sunday morning last, and died in the early hours of Monday morning. His death at the comparatively early age of sixty-seven will be regretted deeply by his many friends, for it is recognised that his illness was directly caused by the prolonged strain to which he submitted himself on behalf of the nation's war effort, both in connection with his business and the public work in which he was so interested.

### EDWARD BROUGH TAYLOR

WE greatly regret to have to record the death, on February 7th, of Mr. E. Brough Taylor, senior partner of John Taylor and Sons, chartered civil engineers, Westminster.

Edward Brough Taylor was born in 1856 in Pimlico. He was the second son of Mr. John Taylor, M. Inst. C.E., who had gained considerable experience in his profession of waterworks engineer and was largely responsible for the design of waterworks at Newcastle-on-Tyne, Cardiff, Bristol, Newport and various other cities; he was also responsible for the construction of extensive works for the Lambeth Waterworks Company and was chief engineer to the New River Company. Mr. Brough Taylor was educated at King's College, Strand, received his early engineering training in his father's office in Great George Street, Westminster, and was later sent to Bristol in charge of extensive works which were being carried out for the Bristol Waterworks Company at that time. In 1882 he and his younger brother, the late Mr. G. Midgley Taylor, M. Inst. C.E., were taken into partnership. Mr. John Taylor died in 1891 and since that date Mr. Taylor held the position of senior partner of John Taylor and Sons, although latterly his health prevented his taking as active a part in professional work as he wished.

After his father's death he continued to advise the Bristol Waterworks Company and was responsible for large extensions of its works. He also designed and carried out very extensive works for the Colne Valley, Chatham, Aldershot and Herne Bay water companies, all of which undertakings obtained their supplies from the chalk, of which formation Mr. Taylor had an intimate knowledge. In the case of the Colne Valley Water Company, he was responsible for the carrying out of over 230 separate contracts, involving the construction of wells, adits, pumping machinery, large diameter mains and service reservoirs. He also advised on various other water undertakings in this country, including Shrewsbury, Church Stretton, Swanage, Slough, Maidstone, Midhurst, Porthcawl and other places in South Wales.

The principal undertaking with which he was concerned outside the British Isles was the Shanghai Waterworks Company, whom he advised for many years, particularly in regard to its extensive pumping plant. In his early years he visited Newfoundland to advise on water supply in that island, and in 1909 he visited Genoa to report on a project for bringing new sources of water supply to that city and the neighbouring districts. Just before the Great War he visited Russia to prepare a scheme for the augmentation and purification of the existing supply to the city of St. Petersburg from Lake Ladoga, and more recently advised and designed works for the city of Karachi.

Mr. Taylor was elected an associate member of the Institution of Civil Engineers in 1881 and was transferred to full membership in 1890. He was also a member of the Institution of Mechanical Engineers and a Fellow of the Geological Society.

# Letters to the Editor

*(We do not hold ourselves responsible for the opinions of our correspondents)*

### PEACE AIMS

SIR,—There is need for a great deal of very hard thinking before it is possible to approach the question of peace. I have very little sympathy with the demand which comes from different and various quarters for some simple statement of peace aims. Simple statements are not difficult, but if they are on the lines of most of the suggestions I have seen, they are very liable to be pregnant with future wars. Our first duty, as I see it, is to strive to discover the causes of this war; Hitler is merely the sore throat brought about by deeper digestive disorders. We fought in 1914 to 1918 the war to end war, and we rejoiced for a time in the mistaken belief that we had accomplished that purpose.

I am struck with the differences between the supposed causes of the two wars. When we fought the Kaiser there was practically no mention of economic problems. The Kaiser uttered platitudes about a place in the sun, having in mind the big red splodges on the face of the globe, but he made no mention of unemployment, of raw materials, of international payments, of difficulties of import and export, or of new social systems. He was only concerned with the addition to his imperial crown of further glory in the shape of widespread lands. All these economic problems, or certainly the great majority of them, have arisen in the last twenty years. The causes, so far mentioned, which have brought about the Hitler war, contain none of the standard or historic reasons for war. Hitler was first of all concerned with the Versailles Treaty, and, curiously enough, a large body of liberal opinion is now inclined to agree with his view of that document. The Versailles Treaty was the first product of the bureaucratic age, 1919–1939.

To endeavour to frame the terms of a peace to end this war, without a very clear conception of its causes would be to imitate the doctor who dispenses with the trouble of a diagnosis. If it is the fact, and I claim it to be so, that the doings of the twenty years between the two wars are entirely responsible for our present distresses, then an inquest must be held on those doings, and it is foolish to allow the doers of those doings to carry on in the same way, and little short of criminal to allow them to frame the terms of peace or even to sketch the future.

The inquiry in its broad outline is fairly simple, for the years 1919 to 1939 are full of political and economic phenomena peculiar to that period; schemes, plans and expedients which had never been suggested in all the ages before the Kaiser's war.

Consider first the old question of Man *versus* the State. In the twenty years between the two wars the State, measured in terms of money, enlarged itself ten to fifteen times. That is true of our State, and in more or less the same proportions of most of the States of the world. It will be agreed that war is the exclusive prerogative of the State; nothing but a State can make a war. A State which has fifteen times as many interests and duties as were previously considered proper has also fifteen times as many reasons for resorting to war. This is a big subject, but worthy of study. If in the future the State is to be accepted as the medium through which all our wants are to be secured, then the terms of any peace do not seem to me to be of much importance. It will be no peace, but merely a period of truce before the next war.

One striking illustration of the growth of the State is to be found in the money markets of the world. In 1913 no Government anywhere, as a Government, owed any money to any other Government. A good deal of money was owing between individuals of the world, and between individual investors and particular Governments, but no Treasuries or Chancellors ever discussed with one another standstill agreements for the payment of debt, the regulation of imports or exports to adjust the balance of payments, or the hoarding of gold, or any of the modern governmental practices. The normal dealings of individuals one with another, especially as between individuals of different nations, may sometimes leave something to be desired, but twenty years' experience of the dealings of Governments with one another in the matter of money alone has made us familiar with depths of trickery, jugglery and fraud such as were unknown before 1913.

But there are bigger questions still. I am an individualist and anything in the nature of collectivism is abhorrent to me. Collectivism is an admission of weakness and the abrogation of responsibility and duty. It does not therefore surprise me that the weak, helpless theory that trouble can be solved by discussion has been exposed by the history of the League of Nations. "Union is strength" is true for war, but not for constructive peaceful purposes. Union, as, indeed, with our own trade unions, sets up a conspiracy on the part of a section against the whole, and that is true of all union backed by force or law. If the coming peace is to include any of the theories tried and proved wanting at Geneva, then again it will be, in my judgment, no peace at all.

Consider all the hard thinking that requires to be done on the much-discussed question of employment. Roosevelt was made President six years ago on the strength of his promise to relieve America of ten million unemployed. He has just been elected again, but the ten million unemployed are still there. Hitler promises the world that under his system there will be no unemployment. Pétain claims to possess a panacea for this ill. Our own Labour Ministers proclaim almost daily that in the new world for which they think we are fighting there will be no unemployment. Lenin and Stalin have in fact abolished the condition in which a man has nothing to do by ordering everybody, as slaves, to appointed jobs, with the safety valve of timber cutting in the jungle or canal building in the Arctic as convenient graves for the odd tens of thousands that are not wanted from time to time. Is it possible that a peace made by politicians, all believing or professing to believe that unemployment can be cured by political methods, can be anything but the hollowest of snares and delusions?

Surely the fact is that we have no prospect of a peaceful world until we have put the State in its proper relation to man, until we recognise that it is the individual who keeps the State and that the State cannot keep the individual, that Government at its

best is an expensive and necessary evil and that the less we have of it the better. We must refresh our memories and deny that the individual has rights without responsibilities. Indeed, we must revive the general philosophy of the glorious past, when this old nation led the world in the right ideas, and did, in fact, keep the peace. We must abandon the collectivist folly in all its forms. The world cannot be run on the theory that nobody must do the right until, after conference, everybody else has agreed to do the same. We must do the world the service of restoring ourselves to our old position and do the right and damn the consequences. That way lies peace.

I run, and run cheerfully, the risk of being charged with failing to put forward what the modern world is pleased to call "constructive" ideas. I am wholly unrepentant. When I contemplate the damage to civilisation inflicted by people with constructive ideas, I glory in the thought that my idea of wise government is to do as little as the ignorant clamour of public opinion will at any time allow. I dream of a peaceful future which is dominated by a strong Britain. But then, unlike my friends among the collectivists, I believe Britain is ordained as the leader of mankind. I have very little use for the theory of equality, and no use whatever for the idea that there is any equality of sense, experience, honesty or character, as between Britain and most foreign countries. This claim I base on the historical circumstance that we alone of all nations of the world have enjoyed nine centuries of steady, consistent education in the art of living together in peace.

Limpsfield. ERNEST BENN.

---

SIR,—A recent evening edition of *The Star* carried an article by the City Editor of which the general purport was to the effect that this war may well involve the liquidation of some two-thirds of our foreign investments; these latter, if I remember rightly, were stated to be about £3600 million and yielded an annual return of £162 million.

If this should prove to be the case, and it may even be an understatement of the final position, then surely this factor is bound to play an important part in the shaping of our Peace Aims and may even take precedence in the discussion as to whether industry is to be State-controlled, or left to private enterprise, or is to enjoy a mixture of both methods.

We cannot fall back on our own self-sufficiency in the same way as can countries like the U.S.A. and the U.S.S.R., which are more fortunately endowed than we are with raw materials and food-producing acres. Our population must live by its own labour in the production of manufactured goods which we export for food and raw materials, and I suggest that to meet the coming situation some form of planned economy will be found essential.

The first thing which it seems reasonable to do is to cure the trade cycle of alternate booms and slumps, which seem to occur every ten years.

In my own view, this cycle is due to the fact that the price level is in practice decided by the method of supply and demand on the market, which ignores purchasing power, and therefore allows the price level to outstrip the latter in time of boom. A price increase can be decided on in half an hour at a board meeting, but a wage increase often takes months of prolonged negotiations; hence, with purchasing power or wages remaining fixed and prices increased, less can be purchased and the conditions for a resultant slump have arrived.

This situation would possibly become clearer by the substitution of an "intrinsic value ratio" for the cost-of-living index, the ratio being a direct proportion between purchasing power and price level. In view of the fact that pre-war statistics indicate that 70 per cent. of the wage earners in this country earned £3 per week or less, this figure might be taken as a unit of purchasing power. Then, if this could purchase, for the sake of the argument, six articles at 10s. each, the ratio becomes 6 to 3. As the boom commences, prices increase 20 per cent. and wages stay level. Then £3 will only buy five articles at 12s. each, and the ratio has fallen 5 to 3. At the height of the boom prices increase, say, by 50 per cent. of their original value, and £3 will then only buy four articles at 15s. each, and the ratio has fallen still further to 4 to 3. It is quite evident that overproduction has now appeared and two industries of the previous six are unable to sell their goods and begin to cut their prices to stimulate a demand. Thus the downward trend of the price level starts, and, assisted by the unemployment caused by overproduction, the purchasing power slides down with the price level to the trough of the depression. When the price level comes within reach of purchasing power and the intrinsic value ratio reaches 6 to 3 again, normal conditions are reached and the process is repeated all over again.

The figures quoted in the above ratio are, of course, not actual ones, but serve as an example. The ratio in practice would have to be calculated on an average consumption of some forty or fifty stable commodities and articles against a wage average as suggested above.

It will be noted that if prices were to remain constant, overproduction due to starved purchasing power would be avoided. Why do prices rise? Surely because the price level responds in practice to market supply and demand, and not to the fundamental economic needs of industry, which are abundant supplies of material at a stable price, fair both to consumer and producer.

It may be said that the central banking system has a powerful means of controlling a boom by the judicious use of the bank rate. By the creation of dearer money caused by raising the rate, industry will have an increased cost to meet in financing its transactions, to take the short-term view of Mr. Hawtrey, and, in consequence, the commodity price level should fall. Whereas this might have been fully the case when London was the market for the world's commodities, and, therefore, was instrumental in practically fixing the world price level of these goods, the impact of the last war saw the removal of many of these markets to other centres, and in many cases back to their own countries of production, and the price level was influenced by other factors. Tariffs helped this movement considerably, and affected prices artificially in consequence. Hence, when large quantities of raw materials have to be bought abroad, in competition with other countries, a rise in the bank rate in making our own money dearer, might, in the last analysis, only succeed in increasing, instead of reducing, the cost of these materials. The only method then would be for the purchasing to be done by the central banks themselves on behalf of, and guaranteed by, the Government. The former event, however, would only increase the price level without increasing purchasing power and thus bring overproduction nearer.

Mr. Keynes deals with the long-term effect of bank rate manipulation, to the effect, if I follow his thesis correctly, that by cutting down the scope of industrial operations by raising the bank rate, the banks themselves will ultimately be obliged to maintain their cash ratio by liquidating their investments or advances. Of the two, investments, particularly gilt edged, are the more attractive proposition for liquidation, and a fall in the gilt-edged security market is to be expected as a result, which would then absorb industrial capital.

Surely, however, the effect on the trade cycle of this might be less beneficial than would at first appear. It is true that the demand is curtailed by this freezing process in the movement of capital and that a fall in prices is thus to be expected; but it has also to be borne in mind that capital is also purchasing power, and that as such it also tends to lead to overproduction when frozen. Hence, both purchasing power and the price level are affected, and the benefits of lower prices are quite possibly cancelled out by the inability of reduced purchasing power to avail itself of the opportunity to adjust the intrinsic value ratio to normal.

Hence, my suggestion is that it is probably preferable to control the trade cycle by means of controlling the price level down to a given intrinsic value ratio, and thereby ensure the fullest possible industrial activity within the scope of the available purchasing power.

The problem, of course, is, How is this to be done? I would suggest that it be done voluntarily by an organisation set up by industry itself, and working in full co-operation with the Government and the central banks.

The fact then becomes apparent that this scheme would need to embrace the whole of industry if the trade cycle is to be effectively brought under control, for any part of industry left outside it would be able to operate quite independently of any planned economy, and might, quite innocently, cause considerable disharmony between itself and the larger

national structure. It would presumably involve the setting up of a kind of National Industrial Federation, which, while each firm would retain its own freedom of action in the organisation and running of its affairs, yet would agree to co-operate with its fellows on the lines indicated above, and for the ends suggested.

I am enclosing a sketch of one such possible organisation, with firms grouped geographically under their area chairmen, and with similar industrial groups operating with their own committees and under their own chairmen. The trades so grouped are by no means a comprehensive section of industry as a whole, but are taken as typical examples which readily spring to mind.

MICHAEL BENKERT.

London, E.C.3, February 14th.

## COSTS AND WAR CONTRACTS

SIR,—I have read with interest the excerpts from the Fourth Report of the Select Committee on National Expenditure, dealing with Government contracts, and also your leading article in connection therewith.

Very few people, I think, will quarrel with your summary, and certainly not the taxpayer, who has to foot the bill and would like to be assured that he is getting his money's worth.

At the same time, it should be pointed out that the Committee's memorandum appears to be drawn up on the basis that all Government contracts are being carried out by well-established firms who are doing practically the same work for the Government that they formerly did for their civilian customers. This is not by any means the case. To utilise our productive capacity to its utmost, and to provide the armaments that are required, it is desirable and necessary to invoke the help of firms to do work which is very different from that on which they were engaged in peacetime. It is in cases such as this that it is impossible to apply the principles of a fixed price contract with any justice to the contractor, and it would appear that neither the Select Committee on National Expenditure nor the Contracts Department have quite grasped the different circumstances of some of the firms to whom I have alluded. Take, for example, the manufacturer of gas stoves or, say, lawn mowers, who is asked to undertake the production of, say, cartridge drawing presses which are urgently required. The lawn mower manufacturer is an expert at his particular job of making lawn mowers, but he knows nothing about making cartridge drawing presses. His machine tools are admirable for making lawn mowers, but they may be very slow and comparatively inefficient on making the parts for cartridge drawing presses. Nevertheless, the cartridge drawing presses are badly wanted, so the lawn mower manufacturer starts to do the job. He has no engineering estimating staff who could work out in detail the cost of the new type of machinery he is about to make, and even if he had his knowledge of the job is not sufficient for any estimate to be accurate within 10 per cent. or 20 per cent.

In cases such as this one submits that the contractor should be allowed to do a substantial batch on a costings basis, and if a target figure is required it should either be a provisional one, variable up and down, or it should be sufficiently generous to secure the manufacturer from loss, in view of the fact that he is venturing over unknown seas.

There must be hundreds of small firms up and down the country who are doing work totally alien from their ordinary products, and where it is very difficult for them, or anyone else, to fix an accurate price. These firms should be treated by the Contracts Department with a little more tolerance and vision than is perhaps done at the present time, and the Select Committee on National Expenditure should recognise this fact, while, at the same time, continuing unabated their efforts to secure the maximum efficiency and economy in regard to all supplies.

WILLIAM N. HALLETT.

Birmingham, February 17th.

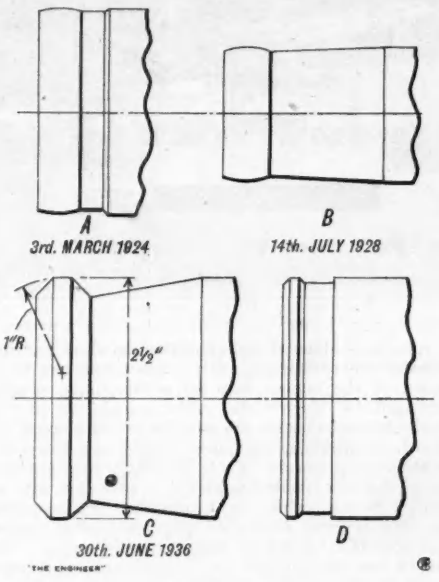
## LOCATING PLUGS

SIR,—In reply to Messrs. Harwood and Dabbs, by wider, yet more precise, consideration let us establish the truth of my previous message in THE ENGINEER, January 10th.

The self-same plug may be used as a registering or locating device, as a test bar for examining alignment, and as a gauge for inspecting size. It frequently is in tool and experimental shops. Three purposes and three names, but only one plug! And what meaning has the noun *plug* until an adjective qualifies it?

What we are really concerned with is a particular way of shaping the end of a prism (or rather an extension from it) to facilitate its entry into a close-fitting hole. Any device which will maintain or practically restore coincidence of axes when the prism is offered to the hole will prevent jamming, provided the respective sizes allow of no real interference. The section of the prism may be any shape, *e.g.*, rectangular, D, or star (splines) or circular. For the present purpose this enlargement of the ordinary meaning of "prism" is clear and convenient.

The extension or pilot in the method being considered is shaped to cause the axes of prism and hole to coincide at one point, when entry has just commenced, but allows (by line or a series of point contacts) a convenient amount of departure elsewhere. As the pilot enters deeper a neck tapering from the pilot up to the full size of the prism gradually makes axial coincidence practically perfect; and then entry can be completed without jamming. For examples consider A, B and C in the figure, or the plug gauges marketed by the Pilot Plug Gauge Company. Then examine D and the figure in my previous letter. These two are different because in their case axial




FORMS OF LOCATING PLUGS

coincidence is restored by the squaring action of an abrupt shoulder.

On A, B, C are marked the dates borne by the original tracings from which they were copied. Blue prints from these tracings were kindly sent to me by the Austin Company for the purpose. For the editor's satisfaction I enclose those prints with this letter. The date on A, March 3rd, 1924, should be noted particularly.

In December, 1929, I saw and admired in the Austin works many examples similar to these. They were in wide, open and (in every sense) free use. The conditions in those works were unusually public, for numerous visitors were encouraged, and from the thousands of employees some left now and again, taking their acquired knowledge of the device we are discussing with them. There were no patent restrictions on the Austin forms in 1929. Therefore there can be none now.

A. C. WHITEHEAD.

Derby, February 10th.

# American Engineering News

### Military Roads for the United States

One result of the war news from Europe is that expert attention is being given to the need of bringing the network of public highways into condition to carry modern military traffic. At first, as a part of the politically inspired agitation for "defence," there was a demand for a brand-new system of military roads, several thousands of miles in extent. But study by the military engineers and the Government engineers of roads showed that there was no necessity for such a radical and costly project. The highway system, with certain minor additions and extensions, is adequate. What is needed is to bring it into some uniform condition as to the main routes for the safe and easy transportation of heavy trucks, motor-hauled gun carriages, and similar equipment, without excessive wear or damage of the roads. At a meeting of the State highway officials from forty-one of the forty-eight States, it was pointed out there will be new characteristics of regular traffic on the highways, including troops on the march, army transport trucks, and motorised ordnance and other military material, as well as traffic concentration near training camps and industrial centres, and in addition an increase in official and general automobile traffic. One line of improvement will be to develop practically parallel roads to distribute the traffic. On secondary routes also there must be extensive widening of the present narrow shoulders. Incident to the roads will be the strengthening of some 2000 bridges to fit them for carrying the prospective loads. As to the value of super-highways, in recent military practice manœuvres a battery made 50 miles an hour easily on the new 160-mile road in Pennsylvania, as compared with 25 miles an hour of rather hazardous travel on the ordinary roads in the same vicinity. Of 75,000 miles of a strategically important highway system, some 20,000 miles do not come up to the requirements of the military authorities.

### Novel Designs in Bridge Piers

A bridge built recently to carry a four-lane high-speed road or super-highway across the Housatonic River consists mainly of plate girder steel spans supported by pairs of steel columns on low concrete piers. But owing to the skew of crossing over the navigable channel, the length of these piers and frames would have been objectionable, unless much longer spans were introduced. Instead, a relatively small circular pier was used, with a single steel shaft or column, 70ft. high, carrying a transverse beam or T head, cantilevered on both sides. The plate girder cross beam is 63ft. long. The column, in section like a hollow cross, is 20ft. by 14ft. in section at the base, tapering to 4ft. square at the top. It is of cellular construction, formed with one central cell and four side cells, all built up with vertical plates and connected by angle irons in all interior corners. Heavy unbalanced wind loads were assumed in the design of these steel piers. Three lines of longitudinal girders have transverse rolled steel beams riveted between their webs, and upon these are seven lines of longitudinal beams carrying a steel grid or open network paving. This open-grid floor eliminates snow troubles, and weighs only 20lb. per square foot, as compared with 54 lb. for a steel grid filled with concrete and 100 lb. per square foot for a typical 8in. concrete slab. . . . To carry a concrete railway bridge over a valley flooded by the reservoir above a new dam, a novel form of pier was used, in place of the usual pair of vertical columns with transverse cap or beam. Each pier is a truncated A frame, 70ft. high, with columns 3ft. square, connected by transverse struts at bottom and mid-height, and carrying a top beam or cap 14ft. long. The 24ft. spans are pairs of concrete girders, 4½ft. deep and 3ft. wide, with a 10in. floor slab, 14ft. wide, on which is the ballasted track. Along one side of the slab is a 3ft. walk, cantilevered and supported by brackets on the girder. Curbs or ribs, 12in. high, along the edges of the slab retain the ballast. Brackets were cast on the transverse beams to carry temporary steel plate girders supporting the forms or shuttering for the concrete girders and floor slab.

# Sixty Years Ago

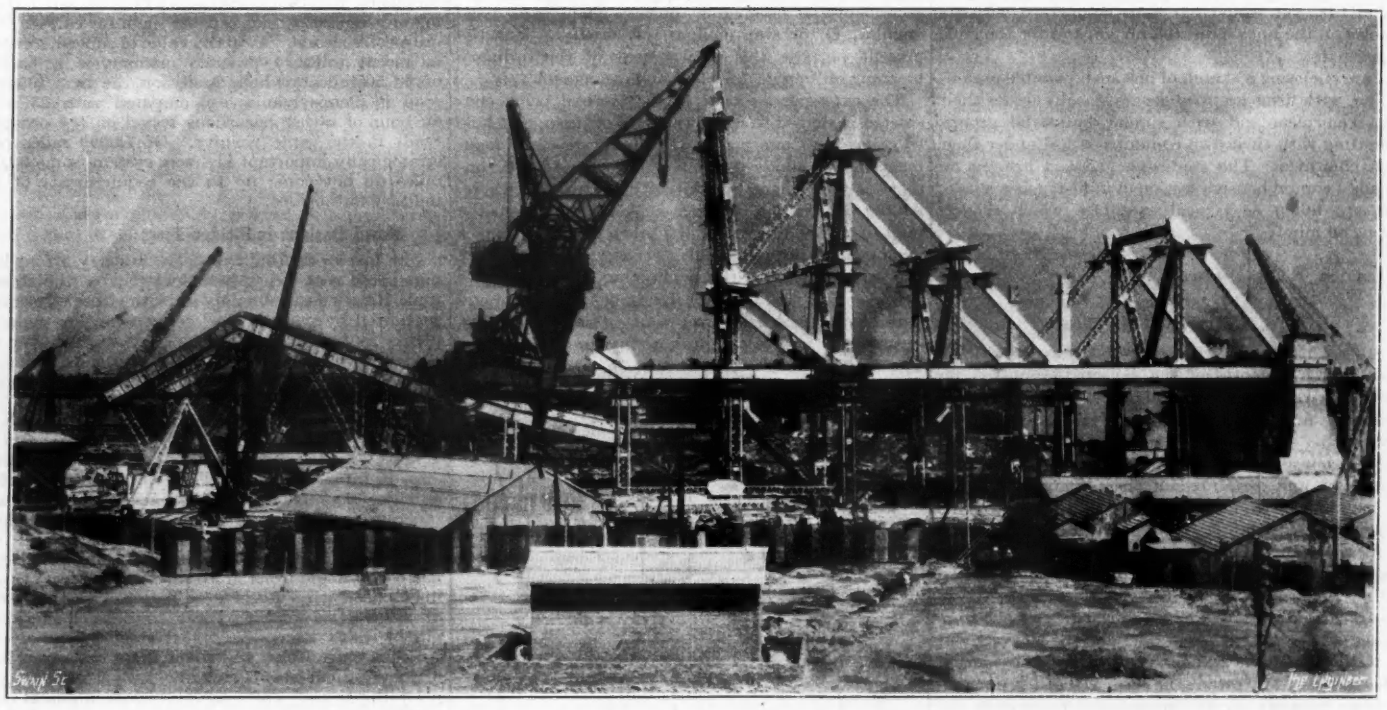
INVISIBLE PAINT

IN the earlier days of the present war the Germans alleged that the British aircraft which were being used over their territory had been rendered invisible when caught in the beam of a searchlight by being painted with some special, but undisclosed, substance. Quite recently the Germans themselves, according to their own statements, have succeeded in evolving an aeroplane which is invisible, or nearly so. In their case, it is asserted, the invisibility is achieved by constructing the aircraft, for the most part, from a plastic material which is all but transparent. It would seem, from a note in our issue of March 4th, 1881, that both countries have been forestalled in this matter by the Japanese, who, nearly a thousand years ago, acquired the art of making things invisible. According to a Chinese encyclopedist writing on the subject of painting, a certain Sir Ngoh possessed a remarkable picture of an ox. Every morning the ox disappeared from its frame—to go grazing, it was said—and every night it returned to its frame to sleep. The Emperor Tai Tsung had the picture brought before him and demanded an explanation of it from his Court. No one could explain the mystery until a Buddhist priest was found who stated that the Japanese possessed the art of extracting a luminous substance from a species of oyster. They mixed this substance with paint. Anything painted with the mixture was rendered invisible by day, but visible by night. To this entertaining anecdote there was added a note to the effect that recently patents had been taken out in this country and elsewhere for a luminous substance produced by calcining and manipulating a mixture of oyster shells and sulphur.

RUSSIAN STEEL PLANTS.—Three large-scale iron and steel plants are to be constructed by the Soviet Union. One will be built near Tiflis, the first of its kind in the Caucasus; the second will be situated on Lake Onega, in the Karelo-Finnish Soviet Republic, while the third, to be called "the second Siberian metallurgical combine," will be situated in Siberia and will be among the biggest in Soviet Russia.

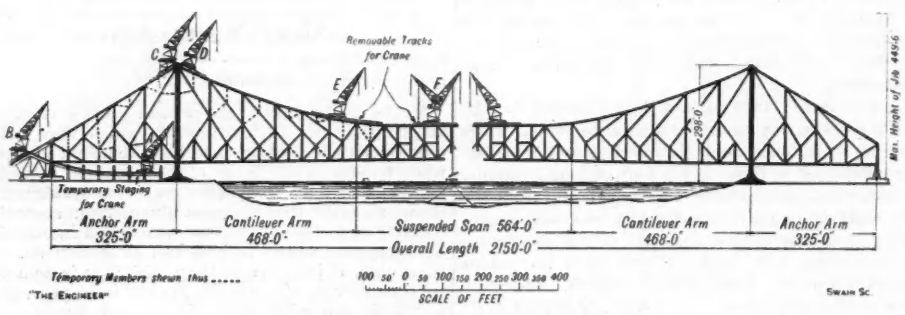
# ERECTION OF HOWRAH ANCHOR ARM OF HOWRAH BRIDGE, INDIA

MESSRS. RENDEL PALMER AND TRITTON, WESTMINSTER, CONSULTING ENGINEERS



## Erection of Howrah Bridge

THE great cantilever bridge across the Hooghly River at Calcutta, which is to be known as the Howrah Bridge, has been mentioned on several occasions in our pages since the contract for its construction was awarded to the Cleveland Bridge and Engineering Company, Ltd., of Darlington, in 1936. We fully described and illustrated the design of the bridge in our issue of November 20th, 1936, and at intervals since we have recorded the progress that has been made in its erection. We may recall that the bridge is to have a main span 1500ft. long made up of two cantilever arms each 468ft. long, and a central suspended section of 564ft. The anchor arms will each have a length of 325ft. The main towers, one of which is almost completed, will rise to a height of 270ft. above the roadway. The bridge, which will carry a roadway 71ft. wide and two 15ft. pathways, has a minimum navigation clearance of 29ft. over the central 200ft. of the span. The clearance increases to 46ft. 6in. at low water.




METHOD OF ERECTING HOWRAH BRIDGE

Wartime conditions have naturally imposed certain hindrances on the task of erecting the bridge, but nevertheless progress has been satisfactory. The sub-contractors for the fabrication of the steel superstructure are Braithwaite, Burn and Jessop Company, Ltd., of Calcutta, and the total weight of steel supplied, excluding the foundations and reinforced concrete work, will eventually reach about 25,000 tons. By the end of last year the erection of the steelwork in the Howrah anchor arm had been almost completed, whilst on the Calcutta shore the erection of the anchor arm was well advanced. The accompanying half-tone engraving illustrates work in progress on the Howrah side of the river.

It will be remembered that the superstructure is being erected by the use of creeper cranes designed especially for the work by the Wellman Smith Owen Corporation, Ltd., of London, and built by the Cleveland Bridge and Engineering Company, Ltd. One of these cranes can be seen in the illustration. Their arrangement was fully described and illustrated in our issue of May 5th, 1939. The sequence of the operations of these cranes is illustrated by the accompanying drawing. Each crane was first erected on a temporary staging close to one of the piers. As it runs back along this sloping staging which extends beyond the anchorage, each crane erects the lower chord of the anchor arm on a temporary staging arranged to support it. After completion of this work the crane begins the erection of the sloping top chord, up which it advances towards the tower top as the work proceeds. Each travelling crane operates on special removable tracks and is provided with an adjustable mast which can be plumbed to compensate for the altering slopes of the temporary staging and the top booms of the cantilever arms. The cranes are also provided with special undercarriages designed to suit the reversal of slope as they pass from the anchor arms on to the cantilever arms. When the cranes reach the tops of the towers they will leave these undercarriages behind and pass on to the top booms of the cantilever arms erecting the cantilever sections as they advance down the slope. Finally, the two cranes will meet near the centre of the suspended span and will there be dismantled.

The engineers responsible for the design of the bridge and the supervision of its erection are Messrs Rendel Palmer and Tritton, of Westminster, to whom we are indebted for permission to publish these notes and accompanying engravings. Mr. A. M. Ward, M. Inst. C.E., is the Engineer to the Bridge Commission.

## Science and the State*

BY DR. A. V. HILL

I HAVE spoken several times of the necessity of guarding the independence, the spiritual integrity of science. In many countries to-day science is wholly subservient to the State; its soul is not its own. I do not deny for a moment the importance—indeed, the necessity—of scientific organisations within the framework of government, or of liberal support by the State of scientific research. One can only welcome such recognition by the public of the importance of scientific knowledge and scientific discovery—and ask for more. There are several things, however, which one may fear. First, the condition of stagnation and complacency which tends to develop in any scientific department or establishment which is cut off from outside criticism or ideas; we have far too many examples of this already, formidable examples, and if we are not careful they will multiply; the reduction of science to official routine can be a real menace. Secondly, the danger that science will be planned by administrators in offices instead of by young men with their sleeves rolled up, in laboratories or workshops. Thirdly, the disadvantage of separating teaching from research, to the great loss of the next generation who may miss the inspiration of seeing discovery going on in the places where they are taught. Fourthly, a decrease in the influence and prestige of those independent scientific bodies which play so large a part in the social and intellectual activities of the scientific community and provide the cross connections between groups which might otherwise be isolated. Fifthly, the danger that he who pays the piper may call the tune, and that research may be required to be devoted primarily to objects which the politician, or the civil servant, regard for the moment as of national importance; or even, as in Germany and the Soviet Union, to bolstering up theories which the official philosophy of the State prescribes.

To avoid all these troubles, the independence and integrity of science must be carefully preserved—in the universities, in the learned societies, in the various associations or institutions devoted to the advancement of knowledge. Whenever State support is given, a buffer should be interposed, similar to that provided by the University Grants Committee between the universities and the Treasury. In our existing Research Councils (Department of Scientific and Industrial Research, Medical Research Council, and Agricultural Research Council), working with Government funds, the buffer is already provided by the fact that the members of the Councils are chiefly independent scientific men. The same safeguard exists at present with much of our State-aided research; we must carefully watch that the strength of this safeguard is fully maintained, that it does not become a formality, and that the principle is consciously extended wherever possible as the financial burden of scientific research and development is taken over (as is bound to happen more and more) by the State.

In many of the Departments of Government, however, notably those of the Defence Services, scientific research is undertaken, on a grand scale, which cannot be controlled directly by outside independent bodies. In these establishments particularly the danger of stagnation and complacency exists. They are devoted to specific service purposes, often of necessity secret, and the condition of secrecy prevents them, in ordinary times, from attracting many of the ablest and brightest minds, who prefer the freer atmosphere of the universities, the possibility of discussing and publishing their results, and the recognition of their colleagues resulting therefrom. Consequently, in war, those who direct these establishments are often people who have arrived at their positions by seniority and long service, during which they have been largely isolated from the ideas and criticism of current scientific thought; it has been difficult for them not to become officials rather than working scientists. When an emergency occurs, as at present, numbers of able men come in but to posts in which they can exert

*Excerpts from an Address to the Parliamentary and Scientific Committee of the House of Commons. January 28th, 1941.

relatively little influence, and their ability and imagination may for long be imperfectly used. This, indeed, is inevitable under the present system, for they have at first no experience of service conditions and needs. After a year or two, perhaps, longer than necessary, these able people find their proper level, but not until much damage has been done by lack of imagination and energy in the posts they might have filled before.

To avoid this trouble—and it is a very real one—two main principles may be applied. First, to introduce into each department or organisation some kind of scientific advisory council, similar to that which, on the whole, works so well now in the Ministry of Supply. This council should consist partly of independent scientific men chosen for their special knowledge on the one hand, for their wide contact with the scientific community on the other, and partly of official scientific people representing not only the department or organisation itself, but a variety of other departments, so that a good cross section of official knowledge and experience is available. And secondly, in ordinary times to arrange for regular interchange of personnel between the Government research establishments and organisations, and the universities and other independent institutions in which research is carried on.

I know that this second proposal will shock some of those who have lived in the traditional secrecy of service science; but it is right all the same. Why should not a chemist or mathematician from Woolwich, a physicist from Signal School, an engineer from the Royal Aircraft Establishment, go back as a lecturer or professor to a university, or to the research staff in a commercial laboratory, just as a physiologist from the National Institution for Medical Research, or an aeronautical engineer at the National Physical Laboratory, or a zoologist at the Marine Biological Laboratory at Plymouth may do? And why should not the research workers in Government laboratories be just as regular attendants at the meetings of scientific societies as those in other institutions? I sometimes thought, before the war, how good it would be to take a mission, harmonium and all, to one of the most important—and the most dead-alive—of these places and try to stir up a little general scientific enthusiasm.

It is difficult to get over vested interest and tradition in these things. As regards the first desideratum, that of an independent scientific advisory council within the framework of a Government organisation, from a department where it does not not exist already, we are apt to get the reply from the political head or the permanent secretary, "When we want scientific advice we can always go to Sir X. Y.," not realising that Sir X. has sat in an office for years and that anyhow he cannot be knowledgeable on everything. Or we are told that the department has an excellent scientific organisation of its own, which has, in fact, gone on without any expert criticism for many years, saved, indeed, from criticism by its well-preserved secrecy. Or it is said, "When we want scientific help we can turn to the D.S.I.R., the M.R.C., or the A.R.C., as the case may be." Those excellent bodies can, in fact, do much, but they cannot do more for other departments than answer specific questions. A large part of scientific work lies in formulating the questions to be asked, and that cannot be done except by people who are in close personal touch with the actual needs. A family doctor, in fact, is wanted, to watch over the scientific health of the department; to call in a consultant alone at intervals is little use; the family doctor must be available to realise the need and to understand the situation of the patient—then the consultant's advice is valuable. The three research councils are to be regarded as consultants, excellent and essential ones; but they do not make it unnecessary to have independent advice within a department.

* * * *

One great advantage of working in the scientific establishments, either of the Government or of a large company or corporation, is the fact that equipment is not limited below the minimum that is necessary for efficiency. In most of the free institutions, money for research is notoriously short. One of the great needs of research is better financial support, and in the relative poverty of charitable people and bodies to which I fear we must look forward for some time, this support will have to come from the State. One hears proposals made, for example, for a national research council to be set up to administer grants for research. In considering such proposals we should be wise to remember three principles:

(*a*) That a powerful buffer is required to prevent the State from interfering with the integrity and independence of research, and to save research from being over-planned and directed by officials sitting in Government offices.

(*b*) That it is often better to ask existing and experienced agencies, which we know to work, to undertake new jobs, in spite, perhaps, of apparent imperfections in their organisation, rather than to allow our young revolutionaries to scrap the old and set up new schemes, cleaner on paper, but untried.

(*c*) That the chief value of research grants will often be to young and comparatively unknown people, so that as far as possible devolution of allocation should be adopted, and the responsibility left to the university or other institution in which they work and where they are known.

* * * *

One last word. In recent years a number of brilliant revolutionaries, filled with political zeal, but without experience of affairs, have won great fame and applause by showing how science is going to change the face of society. The public is inclined to place these gentlemen on the same intellectual pedestal as Einstein, supposing that their science is as great as their chatter. The more responsible members of the scientific community are a little frightened by these activities—not because they grudge their colleagues their easy fame—but because the impression is put about that scientists as a whole claim to be allowed to dominate policy, and so resistance is aroused to their more modest suggestion that they ought to be consulted. If these remarks should reach the ears of those on whom the task of formulating public policy falls, they can be reassured. The majority of scientific men are quite reasonable and have no grandiose ideas. We know our own limitations, as we are well aware of yours. All we ask is that we should be considered as equals in a common task, not merely as superior technicians paid to dish up the magic which you order.

## Compact Galvanometer Scale Unit

THE use of reflecting galvanometers for various routine and industrial measurements, notably in quantitative spectro-chemical analysis with the microphotometer, has shown the usual lamp and scale arrangement to be wasteful of space and inconvenient in use. This compact galvanometer scale unit has been designed to overcome both these drawbacks of the conventional arrangement.

A cast base only 1ft. by 2ft. holds the complete assembly of galvanometer, scale, and reading screen. The galvanometer mount is provided with spring suspensions, properly damped, to reduce vibrational disturbances.

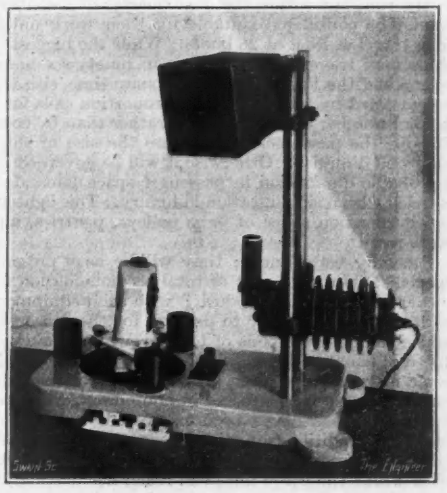
The scale is projected upon a vertical screen, at a convenient height for observation, and deflection of the galvanometer mirror moves the scale image across a fixed index line. This arrangement is particularly convenient when a continuous series of measurements has to be taken, since it avoids the tiring necessity of following the movements of a projected spot of light over the length of a stationary scale. The reading screen is contained in a tubular metal light shield, and is comfortably visible in a well-lighted room. It can be placed wherever the necessary head movements of the observer to see it are a minimum.

The source of light is a 12-volt, 48-watt lamp, for running which a transformer for A.C. or a resistance for D.C. systems can be supplied.

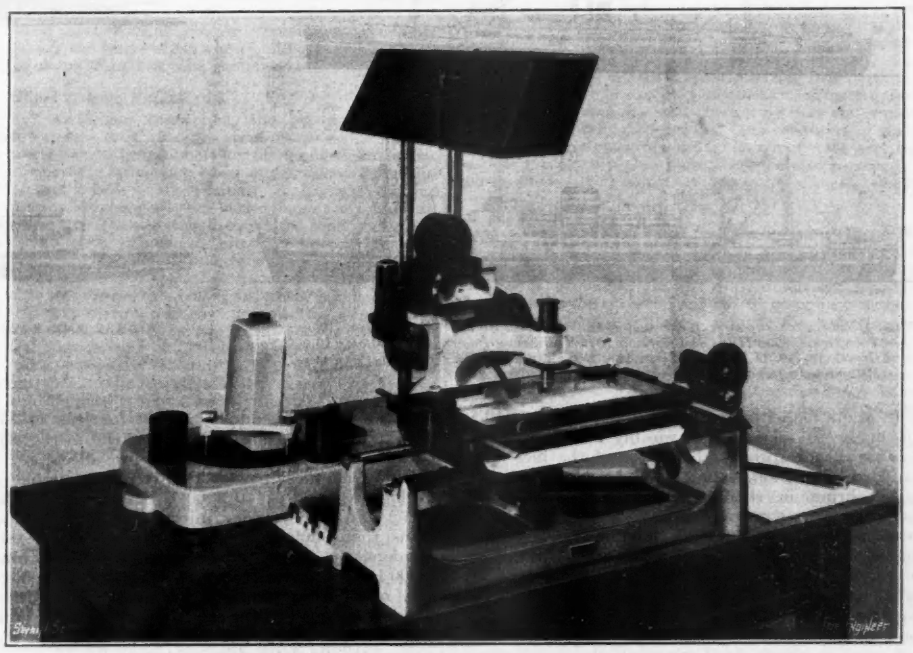
As an example of its compactness, we illustrate its use with the Hilger non-recording photo-electric microphotometer. Here it permits the complete apparatus to be contained upon a bench space only 2ft. 6in. square, whereas the conventional arrangements require a space at least 2ft. 6in. wide by 8ft. deep. The importance of this in an industrial laboratory, added to the convenience and increase of accuracy, consequent upon reduction of fatigue, through using the fixed index method of reading, will be readily appreciated by any who have had to use the conventional apparatus for routine work.

The sensitivity is at least equal to that obtainable with a projection distance of 2 m.

The optical system consists of a low-voltage lamp illuminating, by means of a specially computed condensing lens system, an evenly divided transparent scale. The mirror system, of the galvanometer reflects this scale into the focal plane of a high-quality projection lens, by means of a right-angled prism, and the finally projected, magnified image is reflected upon a translucent screen by a surface reflecting mirror. The actual distance between galvanometer and scale is small, but full-scale deflections are produced by the magnification of the projection system. This, besides securing compactness, reduces the risk of disturbances to the image as a result of vibration, and avoids the use of additional surface reflectors.



GALVANOMETER SCALE UNIT



USE OF GALVANOMETER SCALE UNIT WITH RECORDING MICROPHOTOMETER

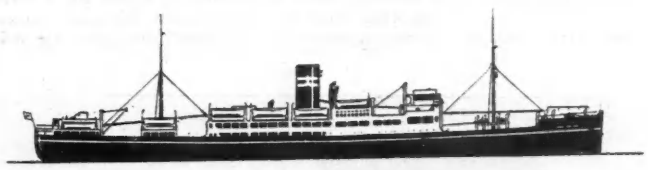
RUST AND COLOUR PHOTOGRAPHY.—Experts in the United States interested in the production and use of paint for iron and steel surfaces are working on new proposed reference standards. The problem is to arrive at accurate evaluations of the degree of rusting exhibited by exposure panels, and the preparation of reference standards of rusting is to be by way of coloured photographs. Preliminary work has made it evident that reference standards will be necessary for two types of rusting failure. The first type would be used in the evaluation of sub-surface rusting (blisters), which has progressed to some degree under the paint film with or without the presence of visible rust spots. The second type is not of the sub-surface type, and is visible as such. Results depended upon two precautions being observed. The first was the selection of the proper colour of paint which would contrast sufficiently with the colour of rust, so that photographically it would avoid any error in interpretation. The second was to choose a surface which would not exhibit rust staining; otherwise rust staining might be confused with the presence of actual rust on the photograph.

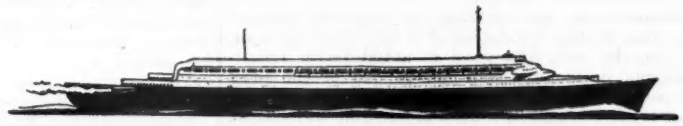
# Ship of the Future*

By A. C. HARDY, B.Sc.

FAST liners will carry passengers and mail surplus to the air routes and a certain amount of freight which, for one reason or another, the air routes do not wish to handle. These must vary in size according to the run, but within the next quarter of a century cannot be considered suitable for their work unless they travel at least at 28 knots. While the biggest of ships may traverse the Atlantic in ninety-six hours or less and the Pacific in proportionate time, size will be governed by speed, which in proportion calls for a smaller number of units per run, rather than by comfort for the passenger. Elsewhere the size of ships may well diminish. Otherwise it will be governed by a probable diminution in passenger space demanded, coupled with a simplification in luxury. This lightens the burdens on space of large galleys, pantries, and store rooms.

Secondly, cargo liners; these will be, as at present, specialist ships with part or total accommodation for meat, fruit, or dairy produce; with such equipment as it may be necessary to develop for the preserved and manufactured foods of to-morrow, and having a speed of about 21 knots fully loaded. Even to-day in some instances the cargo liner is the superior of the passenger ship in speed and in equipment, while her appearance has never been hampered by the old-fashioned tradition (sometimes necessarily) characterising the passenger ship. Nevertheless, the rapidity with which the cargo liner can reach her destination and the comfort offered to the twelve or more passengers carried, has caused larger units to be made obsolete by the newer type (see Fig. 1, a decade of progress). The carriage of lumber or timber, and oil in its various forms, will call for further developments of existing types on the cargo handling side. Tankers





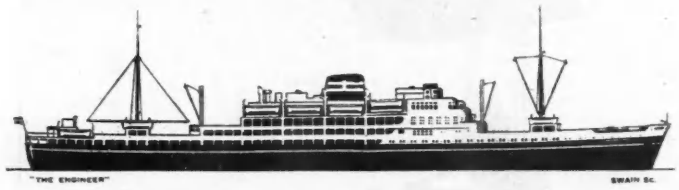
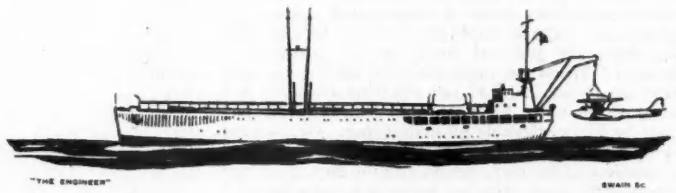



FIG. 1—*Ships for Japanese Westbound Round-the-world Service via the Cape. Top*: 9626 *Tons Gross*, 6000 *H.P.*, 60 *First and* 1076 *Third-class Passengers. Bottom*: 13,000 *Tons Gross*, 16,500 *H.P.*, 101 *First*, 138 *Second and* 662 *Third-class Passengers. Note streamlined effect of the newer ship*




FIGS. 2 AND 3—*Streamlined Transatlantic Liner of the Future and Flying Boat Servicing Ship*

of 18 knots loaded speed exist already and speed is not likely to increase measurably for some time. Because of the speed and because of the increasing standard of comfort which altered social conditions should bring in their train, and complementary machinery developments will provide, cargo liners will naturally attract passengers. Whether these will still remain the statutory twelve or whether upwards of forty will be accommodated, as would be possible within the space available, is only a matter for a change in existing legislation. This, whether in the form of tonnage measurement or of life-saving requirements, will need to adapt itself very rapidly in the years ahead. Brutal war conditions are now advancing life saving enormously to the later benefit of peacetime ship design. Just as peacetime design of buildings ashore may have to take air raid precautions into account, so it may well be that the designer of the ship of the future will make her bomber-proof. We may, in fact, see protected bridges and decks; possibly the elimination of deck hatchways in certain types and the use of side doors with freight lifts intercommunicating the decks. The coastal ship of the eastern seaboard of the United States provides an example of hatch elimination and a basis for this design.

It may be assumed that the above ships will operate independently of aircraft, neither carrying nor servicing them. An important ship of the future will be designed to carry out either or both these functions, on the one hand with land machines and on the other with seaplanes or flying boats. Designs have been prepared in America for large passenger ships whose smooth streamlined hull presents a flat top deck suitable for landing and taking off. The military uses of such a ship are clear; its peacetime value is not so obvious unless an extension of the old ship-shore air mail is planned. A proposed streamlined Transatlantic liner of the future, in which such an arrangement would be possible, is shown in Fig. 2. A more likely type is the floating seaplane base as an adjunct to transocean flight (Fig. 3). It will cruise on ocean flying routes and will form the basis of design of to-morrow's salvage ships, the use of an aircraft on which, for casualty spotting and/or carrying lines and supplies, is clear.

## PROPULSION

In which direction then is it easy to take jumps into the future? Most fascinating perhaps is to discuss what the propulsive system is likely to be in the ship of to-morrow. Many people think that it is bound to be the internal combustion engine, because of the low fuel consumption per twenty-four hours. Others suggest that equal modesty as regards space required for power delivered can be obtained by a really modern steam plant having high-pressure water-tube boilers with superheat, or, better still, fuel valve boilers and geared turbines. It is argued against this that the first cost of modern steam plant is so high, and the difficulty of getting competent operators so great, that the owners of all save special high-powered craft and other particular ships, who think in terms of the ship of to-morrow, are bound to turn for the solution of their problem to the more logical developments of the internal combustion engine. These concern airless injection, the space control of "parasitical" loads (among which the production of scavenge air is important), high speeds of rotation, alloy materials, welded structures and the gearing of two or more units to the common shaft. The use of horizontal *vis-à-vis* oil engines pioneered for marine work in the ships of the Nelson Line over a decade ago is likely to come into its own. More important still for the future is the eventual revision of the tonnage regulations which now penalise the ship with the smallest engine-room. When measurements for net tonnage were drawn up they were undoubtedly framed to assist the men who went to sea. It was considered iniquitous that the shipowner should endanger the lives of those whom he employed by making a small machinery space, for this in turn suggested an underpowered ship at the mercy alike of wind and waves if bad weather prevailed.

To-day the most powerful oil engine available can develop anything up to 3000 B.H.P. in one double-acting two-cycle airless injection cylinder, which means that 9000 H.P. can be developed in three cylinders, or, if a twin-screw ship be suggested, 18,000 H.P. in six cylinders in a length less than 50 per cent. of that required for 1800 H.P. in sixteen cylinders a quarter of a century ago. Such a power plant to-day is theoretical for two reasons: first of all because the final touches needed to lift the engine from the experimental to the practical must needs wait the termination of the war. Secondly, if such power were placed in minimum space with cutting down of uptakes the tonnage measurement would be unfavourable. The same would be true, too, of really modern steam plant.

To sum up, let us examine the family tree. Steam developments for the future fall under two heads on the generation side and two on the using side. The former will be sharply divided, if present schools of thought persist. One of these seeks to develop within the framework of conventional water-tube boiler practice, achieving space economy by positioning the boilers and increasing the pressures and superheat. The other foresees the future in terms of the forced circulation or fuel valve boiler, which achieves compactness by rapidity of steam production. Common to both, however, is controlled combustion, which already has permitted a fuel consumption of 0·45 lb. per H.P. per hour. It is conceivable that in the future control of the prime mover will be on the boiler (particularly on turbine installations) rather than on the engine. The "boiler" will be, in fact, in the relationship of a fuel valve to an internal combustion cylinder. In this case the boiler-room will disappear and the boiler will then become an integral part of the prime mover.

It is difficult to visualise great improvements in the turbine except that the use of higher pressures and temperatures will need metallurgy to keep pace with them. In the reciprocator there are two distinct tendencies, and both are following oil engine practice. The direct-coupled set of the future will use a welded structure and possibly hydraulically controlled valves. An up-to-date example of this is the "Batavier III," whose 3000 I.H.P., three-crank compound engine occupies only 13·12ft. in length, weighs 60 tons and uses the same type of control as a Werkspoor diesel. The compound and double compound engine is increasing in popularity. Some observers maintain that the triple-expansion engine without poppet valves on the high pressure and even more the triple expansion engine with an exhaust turbine is a confession of thermal inefficiency.

Indirect steam reciprocators of V or radial type with gearing or hydraulic couplings must also be considered, not as a possibility for the distant, but as something definite for the near future. Important in this respect is the Lentz radial uniflow engine. An installation of this kind using two 600 I.H.P. engines has an individual prime mover weight of 1439 lb., or only 2·4 lb. per H.P. The common reduction gear weighs 3872 lb. and the specific weight of the complete propulsion unit is 5·63 lb. per I.H.P. A weight of steam generating plant of 66 lb. per I.H.P. is given —this presumably being of fuel valve type. A specific steam consumption of 6·6 lb. per I.H.P. per hour is claimed, resulting in only 0·66 lb. of coal per H.P. per hour.

The above figures indicate something of the future steamer, coal or oil fired. But if coal is to be used it must be independent of human handling from bunker chute ashore to furnace front. There is a good immediate future for mechanical stokers. Indeed, the survival of coal as a maritime fuel for limited purposes depends on it. A limited and special group of ships of the future will probably have gas engines of the dual fuel system; that is, oil or gas, with the latter "bunkered" in flasks or bottles.

The oil engine has advanced so far ahead of the steam engine in the last twenty-five years that its future is assured. Its main virtue lies in its fuel consumption of 0·35 lb. per H.P. per hour with comparatively high thermal efficiency. Improvements will come in the direction of welded structures, higher speeds of rotation, lighter weight and indirect drive. The ship of the future may well use high-speed horizontal *vis-à-vis* engines in association with electric A.C. drive. This would permit of the virtual elimination of engine casings with the running of 'tween decks all fore-and-aft, portable plates for major engine-room repairs, and trunking for ventilation. Electric ships will not increase numerically in the future, finding best use in special auxiliary craft.

## THE MODERN SHIP

Let us therefore establish that the "modern" ship, using the term in its widest sense, is the compound of work done or to be carried out under the following heads:—

1. Efficiency devices added to existing hulls to improve their performance. These comprise fins, rudders, streamlined stern posts with or without machinery improvements.
2. Special and patented hull forms, with which may be associated special bows and sterns.
3. Streamlined and what may be termed for want of a better word "agglomerate" superstructure in which ever-increasing use is made of glass. Superstructures, especially of passenger ships, are now being built up in castellated form, each deck shorter than the one below.

The ship of the future will be more and more streamlined, and in the distant future we may well see special units with glass employed structurally to an extent never before imagined, for in all classes of tonnage there will be a borrowing of ideas from aircraft design. As a detail, increasing use of electricity may dictate the use of cranes capable of flush stowage at sea instead of derricks in many types. The increasing employment of welding tends to the use of smooth streamlined structures. The all-welded structure may have certain advantages for the future when used for the hull as well as for the superstructure. As, however, the completely welded ship will necessi-

* The Institution of Engineers and Shipbuilders in Scotland. December 17th, 1940.

tate a revision of shipyard practice, this is bound to be an evolutionary process. As far as superstructure—welding's most fruitful field—is concerned, the future should be approached slowly because in the superstructure lies the field of aluminium and its alloys. This aspect of the ship of the future is concerned with lightness combined with strength, at present its main advantage. The use of light metals is bound to increase, and with them yet another change will come over shipyard practice. It will be interesting to see how matters of first cost affect the use. Ideas on this will affect its future, adversely at first. All new materials first have to face prejudice. Wood gave place unwillingly to iron, which was thought too expensive. Up to 1860 crucible steel cost approximately £50 to £60 a ton, when the Bessemer process reduced the cost to £6 to £10 a ton. It may be that some similar development will take place as we pass into this new metal age. Metallurgists are continually improving upon their processes, and the research work now being carried out in light metals for war purposes is certain to yield results that will have a profound effect upon the position of materials in the post-war development period. Aluminium, with its high strength to weight ratio, its ductility, ease and economy of casting and fabrication, low specific gravity and resistance under certain conditions of corrosion, should more and more attract the attention of shipbuilders.

As already mentioned, the small space required by modern machinery of high power, with its consequent effect upon machinery uptakes, is a factor which may later in connection with light metals affect superstructure design.

In the past the subsidised totalitarian states have been the pacemakers in hull and machinery development, as well as in luxury accommodation. How to combat this competition and at the same time to take advantage of all technical improvements within the framework of unsubsidised operation was the problem of shipowning before September, 1939. Upon its correct solution, with national help or otherwise, the future of the shipbuilding and marine engineering industries was then seen to depend. But the ship of the future is truly clay in the hands of many modellers.

## BRITISH STANDARDS INSTITUTION

*All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria Street, London, S.W.1. The price of each specification is 2s. 3d. post free, unless otherwise stated.*

### HEADLAMP MASKS FOR MOTOR VEHICLES

B.S./A.R.P. 36—1941. This specification is one of the series prepared at the request of the Ministry of Home Security. Certain requirements for headlamp masks are laid down in the Lighting (Restrictions) Order, and a drawing of a recommended type of mask was issued by the Ministry of Home Security. This drawing was, in itself, found to be inadequate for ensuring that masks made in accordance therewith would, in fact, comply with the Lighting (Restrictions) Order. A headlamp mask conforming to the specification which has now been issued will secure compliance with the Order when the mask is properly fitted to a test headlamp which is correctly adjusted on the vehicle and fitted with a bulb of the correct voltage and wattage rating. One of the most important features of the specification is that it provides for the first time a definite basis for the testing of a mask. The Lighting (Restrictions) Order lays down that the illumination produced on a vertical surface at any point 10ft. from the lamp must not exceed 2·5 foot-candles; but there is nothing to say whether this amount of illumination applies when the vehicle is stationary or when it is running. If the full amount of light is given when the vehicle is stationary, too much light will be given when the engine is running at speed, since under that condition the voltage across the lamp will be higher than when the vehicle is stationary. The designer of the mask has, up to the present, had to decide for himself whether the mask is to be tested at the rated voltage of the lamp or at some higher voltage corresponding to the voltage which will normally appear across the lamp under running conditions. The result has been that some of the masks put on the market have contravened the Lighting (Restrictions) Order.—Price 4d., post free.

### ENGINEERS' SQUARES

No. 939—1941. This specification is one of the series of British Standards for engineers' precision tools. Like the others in the series, it has been prepared with the co-operation of the manufacturers and in close collaboration with the National Physical Laboratory. Provision is made for squares of three grades of accuracy, namely, reference, inspection, and workshop. For the second and third grades the specification includes sizes of squares up to 24in. length of blade. For the reference grade, however, it was considered desirable to stop at a 12in. size. The differences in the existing practice of manufacturers make impracticable any attempt at a close standardisation of the general dimensions of squares. In so far as the question of rigidity is concerned, it has been considered preferable to include a simple performance test rather than to restrict the manufacturer by closely specifying any individual dimensions. The manufacturer is thus left free to evolve the most suitable design to ensure that the square, as manufactured, will have the requisite rigidity, and that, with reasonable use, this rigidity will be maintained.

# Markets, Notes and News

**The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quantities are f.o.b. steamer**

### The United States Market

Active conditions rule in the American iron and steel markets. This is no doubt partly because of the heavy war requirements of Great Britain, which have affected most departments of the transatlantic steel trade. The blast-furnaces appear to be fully booked for the first quarter. Recently there was an advance of 1 dollar in the quotations for pig iron, which at present stand at No. 2 foundry, 24 dollars; Bessemer, 24·50 dollars; and basic, 23·50 dollars, f.o.b. furnaces, Pittsburg, Youngstown, Chicago and Detroit. On January 1st 202 blast-furnaces were in operation, an increase of one since December 1st. Later in January another restarted in the Pittsburg district and one in Birmingham. The pig iron output then reached 100 per cent. of capacity, or actually 105 per cent. of the estimated capacity. Twenty-four out of twenty-five blast-furnaces in the Youngstown district are in operation, the one idle unit being likely to remain so, as it has been partly dismantled. The coke situation is now regarded as satisfactory, although some apprehension was felt a short time ago. The output has been increased by the putting into operation of a number of Beehive ovens, and there have been fairly large imports of British coke. It is known that the administration desires to prevent the prices of pig iron rising. The scrap trade is doing little at the moment, as it is awaiting an approved price basis and it is hoped to discover a formula for a settled differential between scrap and pig iron prices. The railways sold their scrap for January at 22 dollars for No. 1, d/d Pittsburg. The machinery makers, although they carry good stocks of pig iron, are buying unobtrusively in anticipation of a possible tightening of the position later on, and in some cases have bought for twelve months ahead. The latest reports give the production of steel at the principal centres as being at an average of 97·1 per cent. of ingot capacity, whilst some works are operating at 100 per cent. to 105 per cent. of capacity. Market conditions are satisfactory and the amount of business coming forward is in excess of deliveries, particularly in the case of heavy rolled shapes, plates and hot rolled bars. Consideration is being given to the anticipated heavy demand for steel in 1941, and a prominent production engineer has been asked to make a report to the Government. The trade itself believes that the present capacity and the new construction with improved practice should meet all demands. In one week in January the steel output was 1¼ million tons, or at the rate of about 78 million tons per annum.

### The Pig Iron Market

All things considered, the pig iron situation appears satisfactory, since, in spite of the enormous and increasing demand, consumers are obtaining their requirements, the only stringency being in the case of hematite. The improvement in the position of the light castings foundries, which generally are busier than at any time last year, has strengthened the demand for high-phosphoric grades, but is not sufficient to throw any severe strain upon productive capacity. The one thing that consumers have to complain about is that they have frequently to use a brand to which they are not accustomed, but it is recognised that at a time like the present this is an inconvenience which must be put up with. On the North-East Coast the production of Cleveland foundry iron is small and intermittent, and the consumers in that district draw most of their needs from Midland furnaces. By getting pig iron supplies for consumers from the Midlands the blast-furnaces on the North-East Coast are left free to produce basic iron for their associated steel works. In the Midlands the production of foundry iron is on a good scale and practically all the consuming industries, with the exception of the light castings makers, are fully employed, so that the iron produced passes rapidly into consumption. In addition to the make of English iron, the foundries are receiving good tonnages of foreign iron through the Control. The demand appears to be principally for low-phosphoric iron and hematite, but lately there has been an expanding request for refined irons. Whilst the light castings industry in the Midlands is more busily employed now than was the case even a few weeks ago, there is still a considerable amount of short time, although more Government work has been distributed amongst the foundries. These, of course, principally require high-phosphoric iron, of which there is no shortage. Hematite supplies, which are sufficiently tight to cause the Control to keep a watchful eye upon distribution and to press alternative irons upon consumers where possible, may improve later on and it is understood that further imports have been arranged.

### The North-East Coast and Yorkshire

The growing weight of the demand, particularly from the armament and munition manufacturers, has led to a speeding up at the iron and steel works, although already they were operating at such a high rate that there was little margin for increasing output. The pressure to obtain deliveries is severe in all departments, and it says much for the efficiency of the distribution and the high rate of production that there is little complaint of delays in deliveries, and that all the war industries are receiving regular supplies. It is generally accepted that it will be necessary to curtail supplies of steel further for those purposes not essential to the national effort, and this means that firms engaged upon ordinary commercial work will have to reduce their requirements yet again. Few works to-day are outside the scope of the war effort, and for this reason the cutting down of supplies of steel for non-essential uses is not likely greatly to disturb the general position. Those steel works on the North-East Coast producing semis have been occupied at capacity for many months, and the home production plus the imports from the United States and some Empire countries have ensured that the re-rolling industry will have sufficient supplies to maintain a good output for a long time. The re-rolling industry has full order books and the production passes into immediate use, since there is an insistent demand for the lighter sections. Recently there has been a slight recovery in the call for heavier joists and sections, as some of the constructional engineers have secured more work after a rather quieter period. The demand from the shipyards, however, appears to be increasing, and although the plate position has become somewhat easier, it is still rather tight. Large tonnages of sections and plates are absorbed by this industry, and so far as can be seen the demand from this source will continue. The steel works in the Yorkshire district are working at full capacity, and the demand for basic steel shows no signs of slackening. It is evident that the production of armaments is proceeding at an increasing rate, and this is reflected in the demand for all classes of steel. There has been an expansion in the requirements of acid carbon steel, whilst all the electric furnaces are busy on the manufacture of alloy and special steels which are being taken up in increasing quantities.

### Scotland and the North

Large outputs are being achieved by the Scottish steel works, but owing to the huge demand practically the whole of the production passes immediately into consumption. Supplies of raw material are adequate fully to meet the needs of the steel works, and it is anticipated that operations will be maintained at capacity level for many months. In various directions there is a strong tendency for the demand to expand and makers are already committed for a long time ahead, almost entirely upon work of national importance. The increase in the demand is particularly noticeable in the case of special steels, the output of which has grown considerably and which is still rising. There is a heavy demand from the munition makers and there is little doubt that the requirements of this branch of the industry will expand as time goes on. Large quantities of steel are being taken up by the shipyards and pressure from this quarter is much in evidence. As the production of vessels of all kinds is in process of speeding up there is not likely to be any diminution in the requirements of this industry. The request for plates and sections is exceptionally strong and, in addition, a heavy demand rules for tank and boiler plates, with the result that the plate mills are working under extreme pressure. The call for the heavier descriptions of joists and sections has fallen off to some extent during recent weeks, but there has been no decline in the request for the lighter sections. The tube mills in Scotland are busy and have well-filled order books. The Lancashire market is active and as all classes of consumers, including the heavy engineering industries in that district, are fully occupied, the demand for steel is exceptionally heavy. The re-rollers are working at capacity and there is an insistent request for small bars and light sections. The producers of semi-finished materials are operating at a high rate and the outputs are eagerly absorbed. There is also a considerable business passing in high-carbon and special alloy steels.

### Copper and Tin

There are no fresh features in the situation in this country and consumers engaged upon war work get their supplies with regularity. Copper for non-essential purposes is, of course, not so readily obtainable. In the United States the situation appears to be tight, but there has been no change in prices. Copper for domestic use is still quoted at 12c. and the export price is officially 11·50c. American export licences, however, have been more freely granted for Great Britain and Empire countries, but it is obvious that the Americans now have a perfect excuse for declining to issue licences for the export of metal to possible hostile countries, since her own requirements are considerable and may expand under the stimulus of the rearmament programme. There has been some discussion regarding the domestic price, since it is pointed out that by increasing the figure to, say, 14c. it would bring some of the high-cost mines into production. Against this it is argued that to raise the price to such a level would be uneconomic and that after the war these properties would have to go out of production again. If American output were increased it would possibly mean that more copper would be free in other parts of the world to sell to possibly hostile countries. On the whole, the general view appears to be that it would be undesirable to raise the price above its present level. It is possible, however, that copper will be exported to some South American countries in the form of semis. Japan is apparently getting some copper, but no more than is regarded as her peace-time requirements. . . . The price of tin on the London Metal Exchange has substantially advanced over the week. This was partly due to the recent tension in the Pacific, but it has also been helped by considerable purchases of cash tin and the increase in marine war risk insurance and freight. It is suggested that hedging operations by producers who have subsequently had to buy back their tin have resulted in the tightness in the cash position and to the development of the backwardation. There are, however, good stocks of tin in warehouse in this country.

### Lead and Spelter

The lead position in Great Britain remains satisfactory, but in this market, as in some others, the tension in the Pacific has aroused some concern, since considerable supplies are drawn from Australia. Those industries engaged upon war work obtain their full supplies and fair quantities also are available for ordinary industrial purposes. In the United States the market has become firmer and the price has advanced to 5·65c., New York. The demand is active and stocks are not exceptionally large; indeed, it is suggested that they do not comprise more than one month's supply under present trading conditions. It is suspected, however, that in addition to the known stocks in the United States there are fairly large accumulations in consumers' works. . . . The spelter position remains tight in most countries, but in Great Britain, in spite of the high rate of consumption, users are obtaining their requirements, although those firms engaged upon what is regarded as non-essential work sometimes have difficulty in securing full supplies. In the United States the situation remains tight and there does not appear to be any spelter available for export.

# Notes and Memoranda

## Rail and Road

SWISS LORRIES ON WOOD GAS.—To meet the shortage of petrol from which Switzerland is suffering, the Federal Government is reported to be granting a credit of 8,000,000 francs to meet the cost of converting 1000 lorries to run on wood gas. It is estimated that each vehicle will cost 7000 francs; the owners will repay the Government by instalments.

FIRE-FIGHTING TRAINS.—Three fire-fighting trains have been put into service by the Great Western Railway. They are available night and day at strategic points, and an engine waits with steam up ready to take each to any part of the system. The trains comprise a passenger coach for the eight firemen and a covered truck containing two trailer pumps and other equipment.

MR. H. G. DRURY.—Probably Mr. H. G. Drury had the honour of being the oldest railwayman alive in the world. He was 101 when he died on January 28th, having been born in September, 1839. He joined the old Eastern Counties Railway in 1854, and in 1897 was appointed Superintendent of the Line of the G.E.R., as the E.C. became, and remained with that company till 1904, when he retired.

EXTENSIONS IN SWITZERLAND.—The electrification of the Andermatt-Disentis section of the Furka-Oberalp Railway has been completed from Andermatt to the Oberalp Lake. Pending delivery of the new electric locomotives and motor coaches, the line is being worked in conjunction with the Schöllenen Railway, which joins it at Andermatt. Ultimately the Schöllenen equipment will be converted to conform with the system chosen for the Furka-Oberalp line.

THE LIFE OF SLEEPERS IN CEYLON.—Timber in Ceylon is conserved by the Government and most of the broad-gauge sleepers used in the island have to be imported. The average life of broad-gauge sleepers removed from the tracks during 1939 was 11·61 years. The average lives of the varying species used were: Local hardwoods (various), 12·51 years; imported (Australian jarrah), 10·75 years; imported (creosoted Douglas fir), 14·00 years. Local supplies, which had been falling during recent years, increased during 1939.

PRODUCER GAS IN SWEDEN.—Sweden is making greater progress than any other in the development of the use of producer gas. The number of producer gas-driven vehicles has risen in the past few months from 15,000 to 22,000, of which 14,000 are goods vehicles, and nearly 2000 are omnibuses. The two fuels used are wood and charcoal, and the production of charcoal has had to be considerably expanded, with consumption in gas producers estimated at 7000 tons a week. Production and distribution is supervised by the Swedish State Fuel Commission.

RADIO AND FREIGHT CLASSIFICATION.—The annual report of the Federal Communications Commission for the last fiscal year reveals that an experimental authorisation was granted to the General Railway Signal Company, of Proviso, Ill., for the purpose of investigating the possible application of radio to rail transportation. *Railway Age* states that the proposed service provides a radio telephone communication link between the central control tower of a railway classification yard and the locomotives which are used in the switching operation. The report goes on to say that the messages to be transmitted over these stations will consist of orders relative to the classifying or sorting process that is required at certain strategic points in moving freight between different sections of the country.

## Air and Water

SHIPPING LOSSES.—Mercantile losses by enemy action for the week ended February 10th were nine British ships, amounting to 19,364 gross tons, and four Allied ships, amounting to 10,442 gross tons. The total tonnage loss—29,806—during the week is less than half the average total weekly loss since the beginning of the war.

BRITISH OVERSEAS AIRWAYS.—According to *Flight*, some new equipment is on order for British Airways, including "DH Flamingoes" and Lockheed "Lodestars." Three of the Boeing "Clippers" have been ordered on behalf of the British Government. It is understood that "Guba" is over here and flying on the Lisbon route to supplement our flying boats and the K.L.M. landplanes. "Guba" will be remembered as the famous Consolidated Model 28 boat, which was used by the Archbold Expedition in New Guinea and which made the only crossing of the Indian Ocean from Australia to Africa.

INSTITUTE OF MARINE ENGINEERS' AWARDS.—The Council of the Institute of Marine Engineers has awarded the Denny Gold Medal for 1940 to Mr. Sydney A. Smith for his paper on "Marine Steam Turbine Design," the Institute Silver Medal to Professor E. Forsberg for his paper on "Oil Purifying with Continuous Lubrication," and the Junior Silver Medal and Premium to Mr. R. A. Collacott for his paper on "Heat Insulation of Cold Stores." The Extra First Class Engineer's Medal has been awarded to Lieut. (E) J. F. Tucker, R.N. These awards will be presented by the President, Sir Percy Bates, at the Institute's annual general meeting on Friday, March 14th, at twelve noon, at the Connaught Rooms, London, W.C.2.

BRISTOL CHANNEL PORT DIRECTOR.—The Minister of Transport has appointed Mr. R. Hugh Roberts to be the Regional Port Director for the Bristol Channel Region, which comprises all ports between Fishguard and Bristol. The functions of the Director will be to co-ordinate the activities at the ports within his region in order to secure (1) the most rapid clearance through the ports of goods, whether inward or outward bound; (2) the quickest turn-round of ships; and (3) the best utilisation of available transport facilities. To achieve these ends the Regional Port Director has been authorised by the Minister of Transport to exercise the powers he has hitherto reserved to himself of issuing instructions, general or particular, to the Port Emergency Committees as to the directions they give to the authority at any port for regulating, facilitating and expediting the traffic at the port.

A CONTRACT FOR MOTOR ENGINES.—The Ministry of Shipping, having decided that all British ships shall be equipped with an engined lifeboat, has ordered 500 Morris Vedette engines. These are rated at 6–12 H.P. at 1000–2000 r.p.m. respectively. They are being built for installation in a 24ft. or 26ft. lifeboat.

A NOTABLE REPRINT.—An exposure of the danger of the nationalisation of industry generally and shipping in particular, which was delivered by Sir Kenneth Anderson after the last war under the title "The Seeds of War," has been republished, by his permission, in a recent issue of the *Shipping World*. There was then, as there is now, talk of the State retaining the control of the industry after the Armistice.

## Miscellanea

SHAFT SINKING RECORD.—By sinking 454ft. during May a new world's record for sinking a six-compartment shaft has been established at the new deep shaft on the West Rand Consolidated mine, Krugersdorp. During one month last year the shaft was sunk 441ft., which beat the record for a six-compartment shaft held by the Vlakfontein mine since 1936; 457ft. were timbered and the shaft reached a depth of 1567ft. It is intended to sink it to 5502ft.

A ROTARY FILE.—Lorant and Co., Ltd., of Croydon Road, London, S.E.20, have produced the "Rindis" universal filing machine with a rotating double-sided circular milling file. This has an undercut tooth arrangement, ensuring good cutting action due to the angle at which the material is brought in contact with the teeth of the disc, which is 10in. diameter. This method of filing is suitable for working on materials, such as aluminium, magnesium, copper, and bakelite.

COAL SHORTAGE IN SWEDEN.—Swedish towns are complaining bitterly about coal shortage. Germany attributes failure to get supplies to the difficulty of transport, and advances as a reason for these transport difficulties the sinking of a Finnish ore steamer in the Kiel Canal a week before Christmas. It is only recently that the Germans have been able to widen the canal sufficiently to allow of the passage of coal steamers, the first of which from German North Sea ports has now arrived at Gothenberg.

CO-ORDINATION OF ENGINEERING.—The whole of the engineering industry in Germany has been, and is being, reorganised to provide for a strict application of the principles of leadership, the elimination of wasteful competition, the pooling of research efforts, and the planning for many years ahead. The system since the appointment of a Trustee for Machinery Production in December, 1938, has been developed in other fields with success, according to a report issued by the U.S. Commercial Attaché at Berlin.

ELECTRIC MELTING FURNACES.—The increasing use of electric furnaces for the ferrous metals was emphasised in a paper which Mr. H. F. Walker submitted to a meeting of engineers held in Chicago. The type met the demand for closer control in chemical analysis and physical requirements by the automotive and aircraft industries and had led to extended use of the process. New uses were being found for the various types of stainless steels and many other complex ferrous alloys, the manufacture of which was satisfactory in the electric furnace.

THE DEPTFORD PUMPING ENGINES.—Engineers who had been hoping that one of the Watt engines at Deptford might be saved from the scrap heap will be disappointed to hear that demolition has already been carried so far that nothing can now be done. The cylinder and condenser have gone and the plant is largely dismantled. We may remind them, however, for such consolation as it may give them, that the original Watt cylinder of 1812 and the pump work were renewed in 1843 and that some years ago certain parts were removed and utilised as lamp standards in another of the M.W.B.'s works.

JAPAN NURSES HER INDUSTRIES.—The Japanese Government has increased the subsidy on the production of pure nickel from domestic ores from 2000 to 3000 yen per ton. In 1939, when the subsidy was 1500 yen per ton, a total of 230,000 yen was disbursed. Japan's peacetime nickel consumption is 3500 tons a year. Japan will begin shortly the production of synthetic acetone. The raw material will be acetylene derived from calcium carbide. Except for small quantities produced by the fermentation of maize, mainly in Formosa, Japan has hitherto depended for its acetone supplies on imports, largely from the U.S.A. Yet another scheme intended to produce some two million tons of synthetic fuel in Japan and Manchukuo in 1941 has been held up by the cessation of the importation of constructional materials from Germany. One of the several larger plants contemplated has been partly completed at Omuda, Kyushu, but the others are stopped for the reason indicated.

OIL IN U.S.S.R.—Oil is to be obtained from old oil wells through the application of a method developed by scientists at the Mineral Fuel Institute of the Academy of Sciences of the U.S.S.R. The theory is that only about 25 per cent. of the oil in a well is extracted by ordinary methods, and 75 per cent. remains in the ground. The new process of restoring a well is based on the following principle:—Air under pressure is heated to 500 deg. to 600 deg. Cent., in which state it is blown into the oil stratum. Under pressure of the stream of hot air the oil is easily separated from the sand strata. The oil is carried by the air stream to the working well, 300ft. to 650ft. away. Gas is sucked up by a vacuum pump and oil by an ordinary pump. With an experimental installation of small capacity, 20,000 tons of oil, more than 353 million cubic feet of gas, and about 500 tons of benzine were extracted during the past few months from an area 74 acres in extent.

## Personal and Business

COLONEL H. B. SANKEY and Mr. F. C. LYSAGHT have been elected to the board of Guest, Keen and Nettlefolds, Ltd.

AT the request of the President of the Board of Trade, Sir Charles Innes, K.C.S.I., is to examine the problems of industrial reconstruction after the war.

DR. C. DANNATT has been appointed to the Chair of Electrical Engineering in the University of Birmingham, in succession to Professor B. L. Goodlet.

MR. A. A. SIEVEKING has resigned his position as Assistant Engineer to the Central Electricity Board and has joined the staff of James Howden and Co.

MACHINE SHOP EQUIPMENT, Ltd., has transferred its offices from 124, Victoria Street, to Allington House, 136–142, Victoria Street, Westminster, London, S.W.1.

MR. C. BARRINGTON and Mr. P. J. R. Tapp have been appointed Chief Road Haulage Officers in connection with the Government's new road haulage scheme by the Minister of Transport.

MR. A. H. HALL, C.B., whose retirement from the post of Chief Superintendent, Royal Aircraft Establishment, should normally have taken place, has consented, at the request of the Minister of Aircraft Production, to continue in the post until July.

WHITTAKER ELLIS, Ltd., civil engineering and public works contractor, of 54, Victoria Street, London, S.W.1, has appointed Mr. Paul H. Mangin to be managing director in succession to the late Mr. Donald W. Ellis, who died as the result of enemy action on September 9th.

RUBERY OWEN MESSIER, Ltd., Warrington, informs us that Mr. A. G. B. Owen has been appointed managing director, and will continue to hold the office of chairman, which he already occupies. Mr. S. Sanders has resigned his directorship; and Mr. H. S. Price has relinquished the position of general manager to take up an appointment as manager of the armour plate department of the associated company, Rubery Owen and Co., Ltd., Darlaston, South Staffordshire. The position of general manager of Rubery Owen Messier, Ltd., has been filled by the appointment of Mr. Leslie Rumley.

## Forthcoming Engagements

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.*

**Bradford Engineering Society**

*Monday, March 10th.*—Technical College, Bradford. "The Hydraulic Operation of Machine Tools," H. C. Town. 7.15 p.m.

**Institute of Fuel**

*Thursday, Feb. 27th.*—Connaught Rooms, Great Queen Street, Kingsway, W.C.2. "The Design and Operation of Electric Battery Vehicles," J. Steel. 2.15 p.m.

**Institute of Marine Engineers**

*Friday, March 14th.*—Connaught Rooms, Great Queen Street, Kingsway, W.C.2. Annual general meeting. 12 noon. Luncheon, 1 for 1.15 p.m.

**Institution of Civil Engineers**

*Saturday, Feb. 22nd.*—YORKS. ASSOC.: Grand Hotel, Sheffield. Discussion on Chairman's address. 2.30 p.m.

**Institution of Electrical Engineers**

*Monday, Feb. 24th.*—N.E. CENTRE: Neville Hall, Westgate Road, Newcastle-on-Tyne. "Impulse Testing" (discussion). 6.15 p.m.

*Wednesday, March 12th.*—N.E. CENTRE: Literary and Philosophical Society, Westgate Road, Newcastle-upon-Tyne. "Electric Traction," C. E. Fairburn. 6.15 p.m.

**Institution of Engineers and Shipbuilders in Scotland**

*Tuesday, March 11th.*—39, Elmbank Crescent, Glasgow, C.2. "Wartime Building," R. Fitzmaurice. 6.30 p.m.

**Institution of Mechanical Engineers**

*To-day, Feb. 21st.*—Storey's Gate, Westminster, S.W.1. Annual general meeting. "The Mechanical Requirements of the Royal National Lifeboat Institution," Lieut.-Colonel P. H. Johnson. 2 p.m.

*Monday, March 3rd.*—N.E. BRANCH: Neville Hall, Newcastle-upon-Tyne. "Progress in Marine Engineering as Influenced by the Classification of Ships," S. F. Dorey. 6 p.m.

**Institution of Production Engineers**

*Friday, February 28th.*—Institution of Mechanical Engineers, Storey's Gate, S.W.1. "The Efficient Utilisation and Training of Labour under War Conditions," B. C. Jenkins. 2.15 p.m.

**Junior Institution of Engineers**

*Saturday, Feb. 22nd.*—39, Victoria Street, S.W.1. "Notes on the Mechanical Measurement of Liquid Flow (Water and Oil)," A. S. Ladley. 1.30 p.m.

**North-East Coast Institution of Engineers and Shipbuilders**

*Wednesday, February 26th.*—STUDENT SECTION: Bolbec Hall, Newcastle-upon-Tyne. "Ship Mild Steel," T. Corin. 6.45 p.m.

*Friday, February 28th.*—Mining Institute, Neville Hall, Newcastle-upon-Tyne. "Preliminary Calculations in Ship Design," E. E. Bustard. 6 p.m.

**North of England Institute of Mining and Mechanical Engineers**

*Saturday, February 22nd.*—Neville Hall, Newcastle-upon-Tyne. "The Prevention of Gas Ignition in the Overcut," R. D. Beilby. 2 p.m.

**Sheffield Metallurgical Association**

*Saturday, February 22nd.*—198, West Street, Sheffield. Presidential address, "The Fatigue of Metals," W. E. Bardgett. 3 p.m.